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In re patent application of
R. RICCI, *et al.*

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For: **DELIVERY POINT PACKAGER TAKEAWAY SYSTEM AND METHOD**

COMPLETION OF RECORD

Commissioner for Patents
U.S. Patent and Trademark Office
Customer Service Window, Mail Stop _____
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Sir:

Applicants hereby submits copies of the following patent documents which were cited in parent application No. 10/411,198.

US 6,269,609;

US 6,748,294 ; and

US 2004/0211709 is a US Patent Application Publication of parent application No. 10/411,198.

Applicants believe that these documents are cumulative of the documents already made of record. Applicants respectfully request that these documents be placed in the file of the above-noted application.

Respectfully submitted,
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Graushar et al.

(10) **Patent No.: US 6,269,609 B2**
(45) **Date of Patent: *Aug. 7, 2001**

(54) **APPARATUS FOR SELECTIVE WRAPPING OF PRODUCTS AND A METHOD THEREOF**

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(73) Assignee: **Quad/Graphics, Inc., Sussex, WI (US)**

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Jun. 15, 1999**

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(52) **U.S. Cl.** **53/168**; 53/154; 53/52; 53/203

(58) **Field of Search** 53/154, 155, 168, 53/203, 52; 198/341.03, 341.06, 347.2, 347.4

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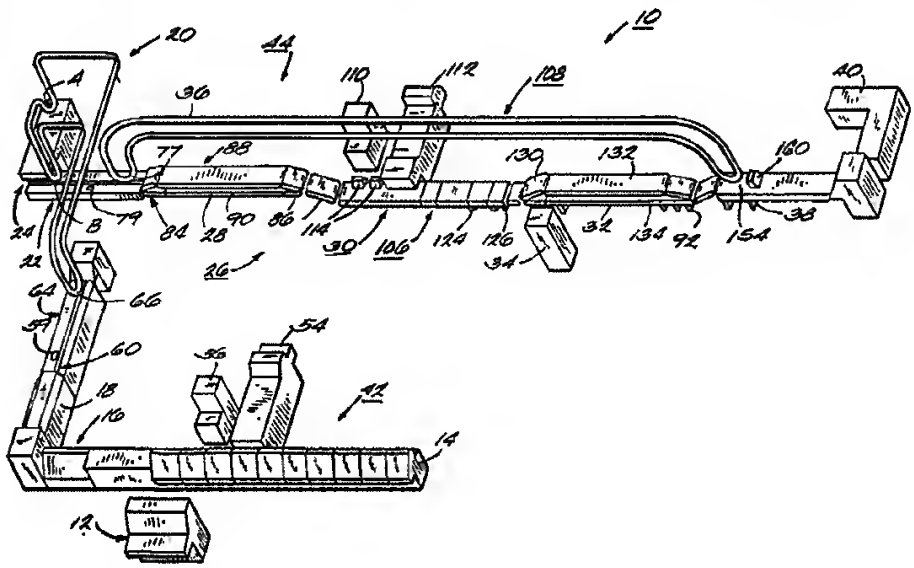
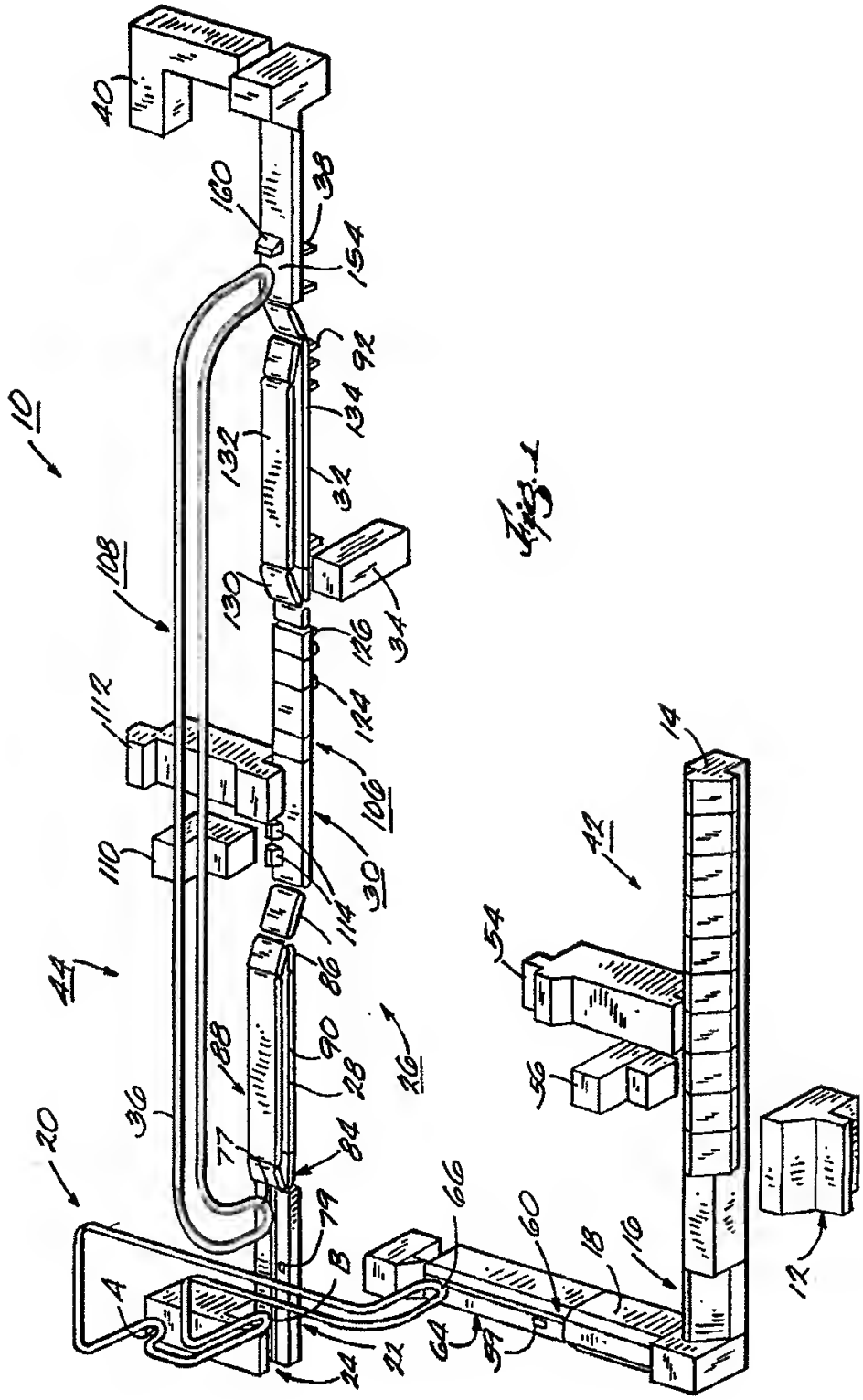
Assistant Examiner—Louis K. Huynh
(74) *Attorney, Agent, or Firm*—Michael Best & Friedrich LLP

(57) **ABSTRACT**

The present invention provides an apparatus and a method to produce magazines, books, catalogues, brochures, periodicals, or the like on a collation or binding line, transport these products in a single stream of products towards a packaging line, divide the single stream of products into distinct streams of products where one such stream comprises products requiring wrapping and another such stream comprises products which do not require wrapping, transport the products requiring wrapping to a wrapping machine and sending these products through a wrapping process, transport the products that do not require wrapping around the wrapping machine, and merge the separate streams of products back into a single stream of products such that the products are arranged in a predetermined output order, such as demographic order.

11 Claims, 6 Drawing Sheets

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86
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A
B

Fig. 1

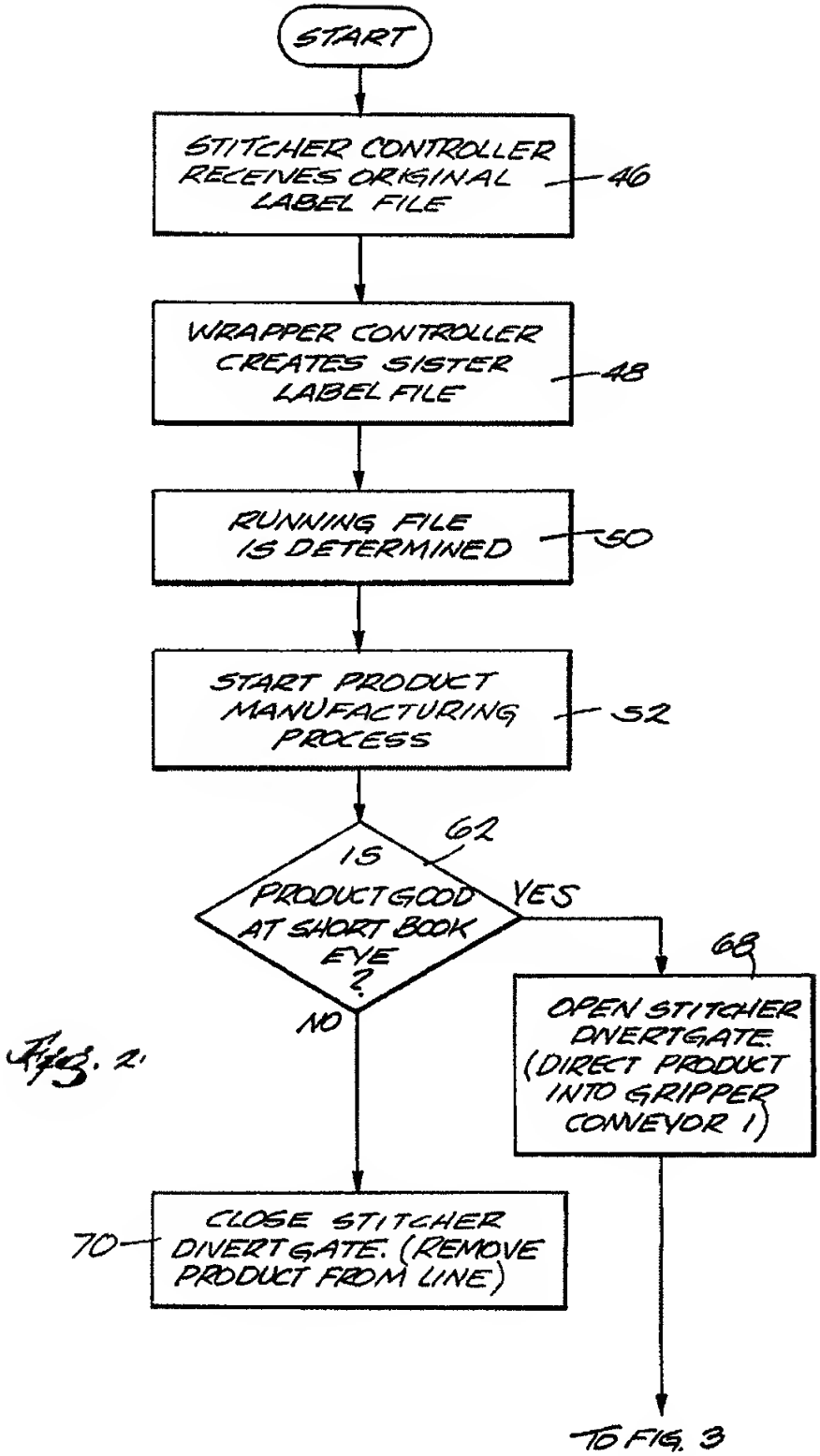
START
STITCHER CONTROLLER RECEIVES ORIGINAL LABEL FILE
46
WRAPPER CONTROLLER CREATES SISTER LABEL FILE
48
RUNNING FILE IS DETERMINED
50
START PRODUCT MANUFACTURING PROCESS
52
62
IS PRODUCT GOOD AT SHORT BOOK EYE ?
YES
NO
68
OPEN STITCHER DIVERTGATE. (DIRECT PRODUCT INTO GRIPPER CONVEYOR 1)
70
CLOSE STITCHER DIVERTGATE. (REMOVE PRODUCT FROM LINE)
TO FIG. 3

Fig. 2.

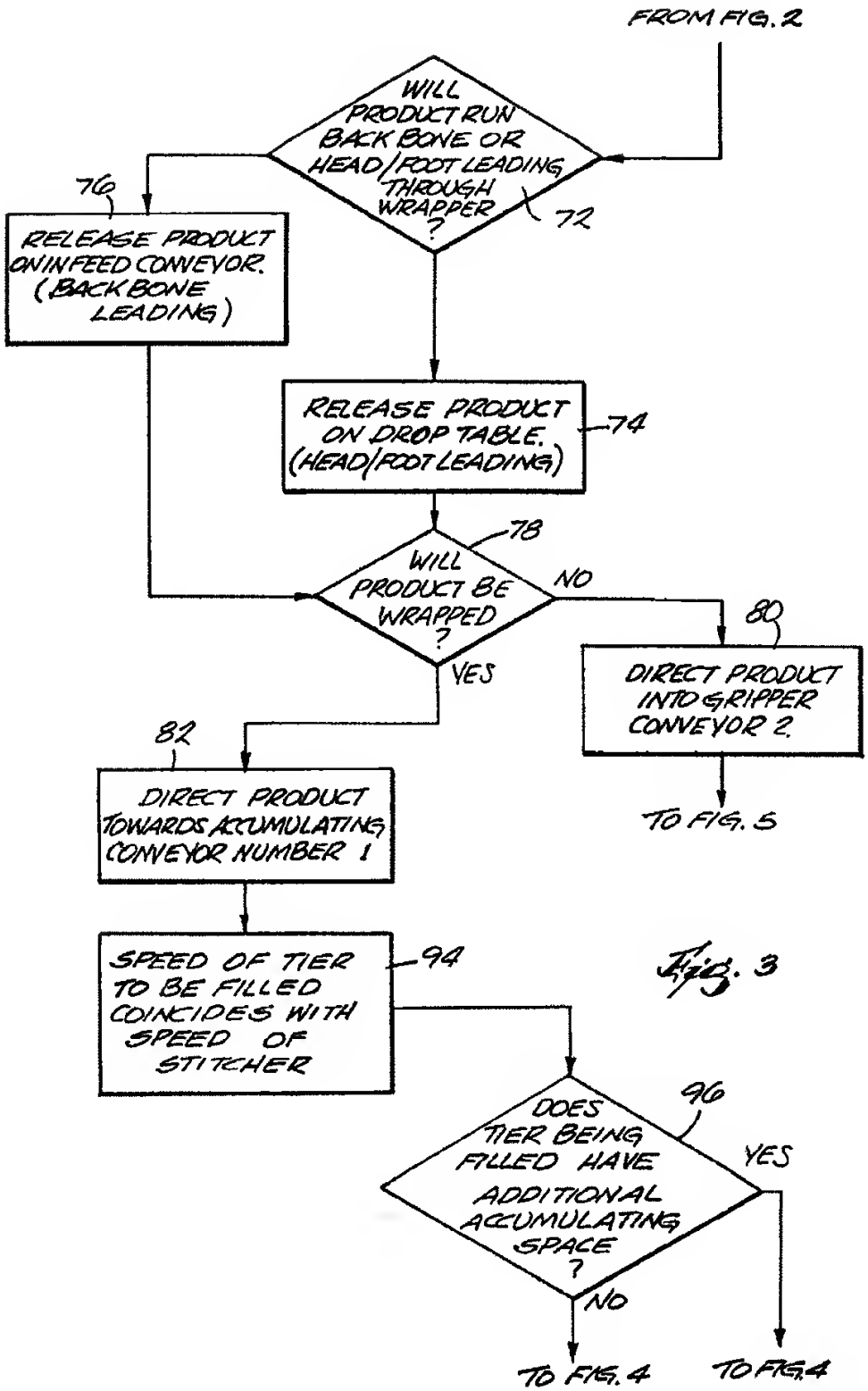
FROM FIG. 2
WILL PRODUCT RUN BACK BONE OR HEAD/FOOT LEADING THROUGH WRAPPER ?
72
76
RELEASE PRODUCT ON INFEED CONVEYOR. (BACK BONE LEADING)
RELEASE PRODUCT ON DROP TABLE. (HEAD/FOOT LEADING)
74
78
WILL PRODUCT BE WRAPPED ?
NO
YES
80
DIRECT PRODUCT INTO GRIPPER CONVEYOR 2.
TO FIG. 5
82
DIRECT PRODUCT TOWARDS ACCUMULATING CONVEYOR NUMBER 1
SPEED OF TIER TO BE FILLED COINCIDES WITH SPEED OF STITCHER
94
96
DOES TIER BEING FILLED HAVE ADDITIONAL ACCUMULATING SPACE ?
YES
NO
TO FIG. 4
TO FIG. 4

Fig. 3

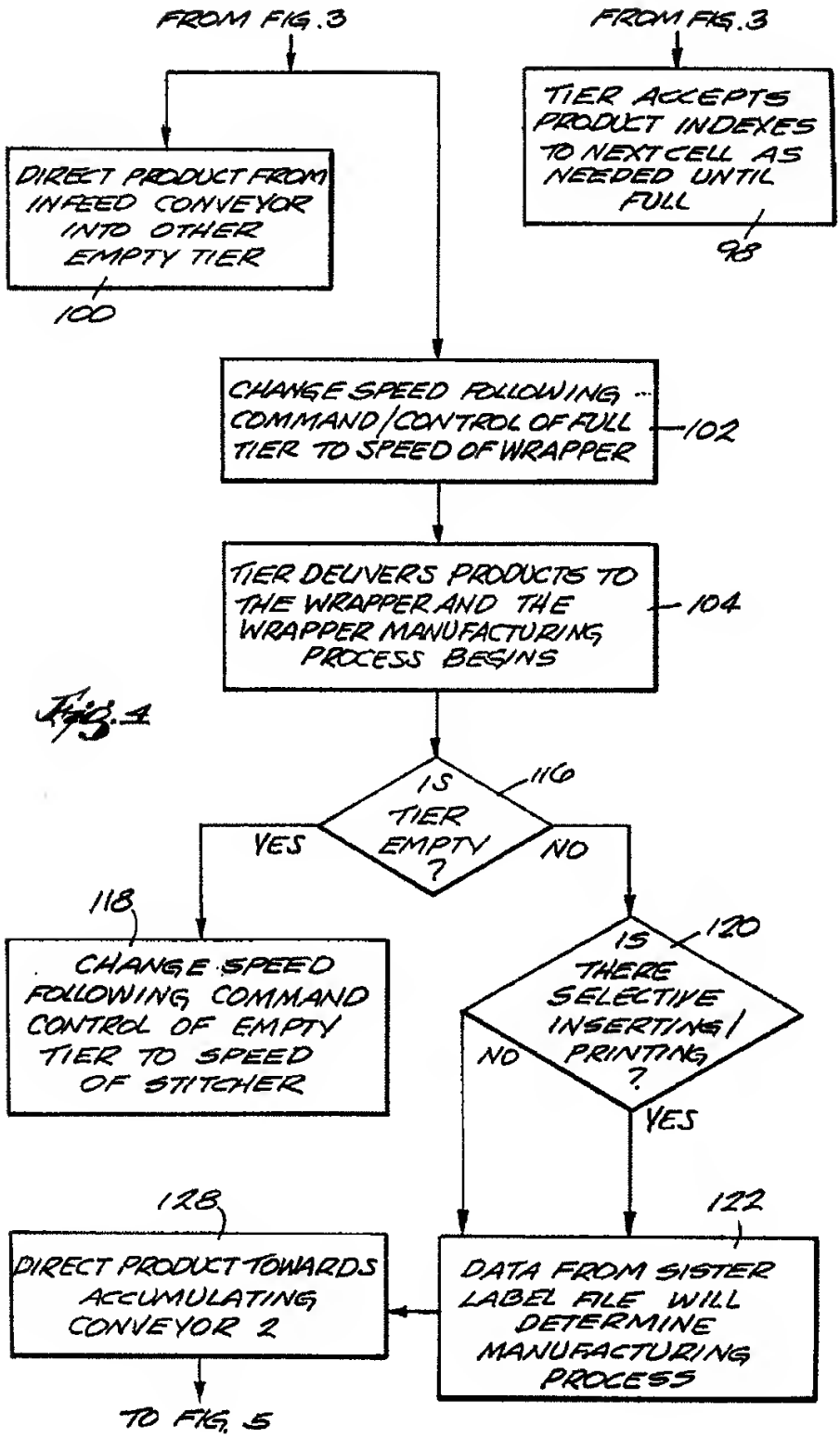
FROM FIG. 3
FROM FIG. 3
TIER ACCEPTS PRODUCT INDEXES TO NEXT CELL AS NEEDED UNTIL FULL
98
DIRECT PRODUCT FROM INFEED CONVEYOR INTO OTHER EMPTY TIER
100
CHANGE SPEED FOLLOWING COMMAND/CONTROL OF FULL TIER TO SPEED OF WRAPPER
102
TIER DELIVERS PRODUCTS TO THE WRAPPER AND THE WRAPPER MANUFACTURING PROCESS BEGINS
104
IS TIER EMPTY ?
116
YES
NO
118
CHANGE SPEED FOLLOWING COMMAND CONTROL OF EMPTY TIER TO SPEED OF STITCHER
IS THERE SELECTIVE INSERTING/PRINTING ?
120
NO
YES
128
DIRECT PRODUCT TOWARDS ACCUMULATING CONVEYOR 2
122
DATA FROM SISTER LABEL FILE WILL DETERMINE MANUFACTURING PROCESS
TO FIG. 5

Fig. 4

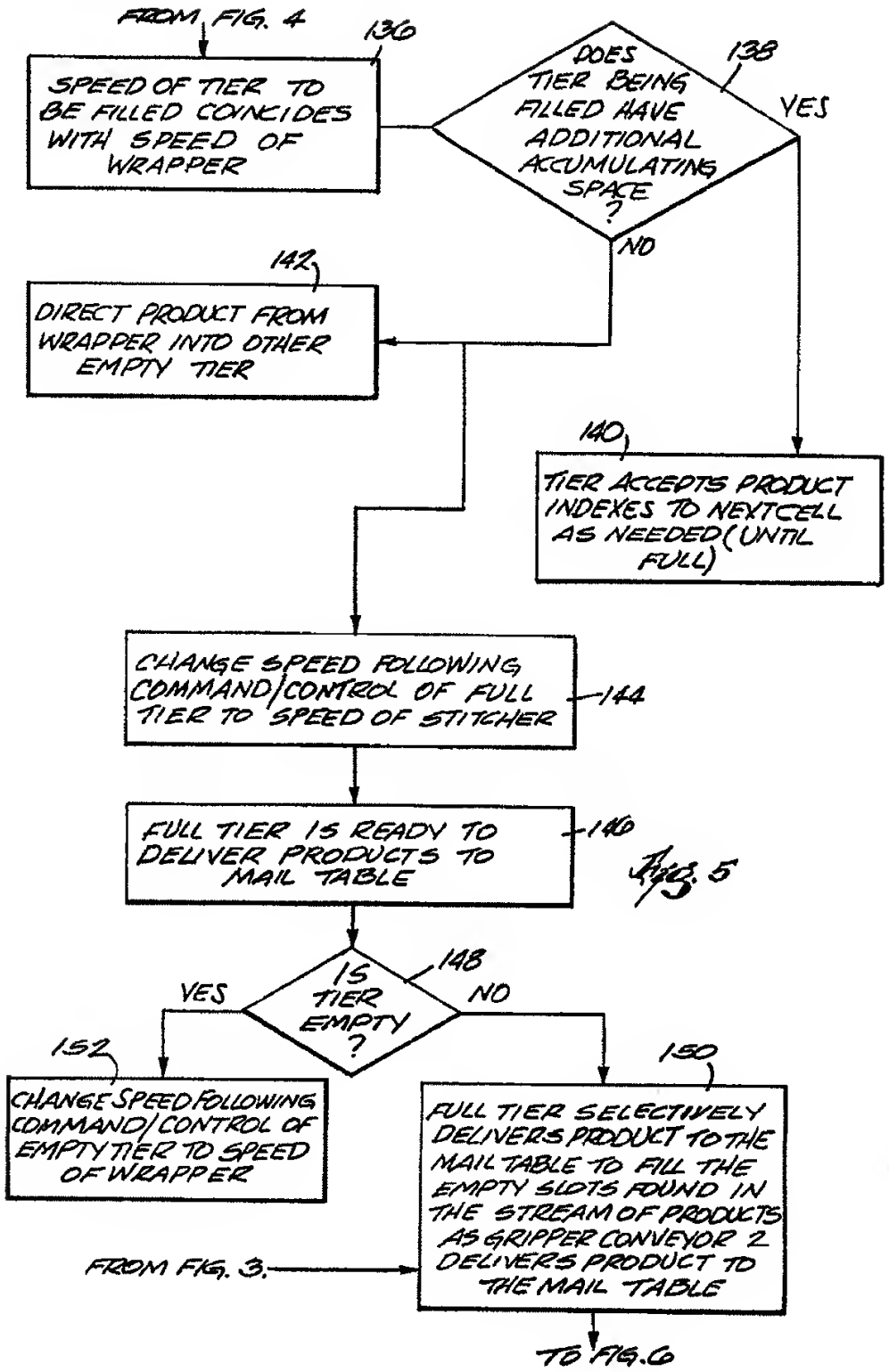
FROM FIG. 4
136
SPEED OF TIER TO BE FILLED COINCIDES WITH SPEED OF WRAPPER
138
DOES TIER BEING FILLED HAVE ADDITIONAL ACCUMULATING SPACE ?
YES
NO
142
DIRECT PRODUCT FROM WRAPPER INTO OTHER EMPTY TIER
140
TIER ACCEPTS PRODUCT INDEXES TO NEXTCELL AS NEEDED (UNTIL FULL)
CHANGE SPEED FOLLOWING COMMAND/CONTROL OF FULL TIER TO SPEED OF STITCHER
144
FULL TIER IS READY TO DELIVER PRODUCTS TO MAIL TABLE
146
148
IS TIER EMPTY ?
YES
NO
152
CHANGE SPEED FOLLOWING COMMAND/CONTROL OF EMPTY TIER TO SPEED OF WRAPPER
150
FULL TIER SELECTIVELY DELIVERS PRODUCT TO THE MAIL TABLE TO FILL THE EMPTY SLOTS FOUND IN THE STREAM OF PRODUCTS AS GRIPPER CONVEYOR 2 DELIVERS PRODUCT TO THE MAIL TABLE
FROM FIG. 3.
TO FIG. 6

Fig. 5

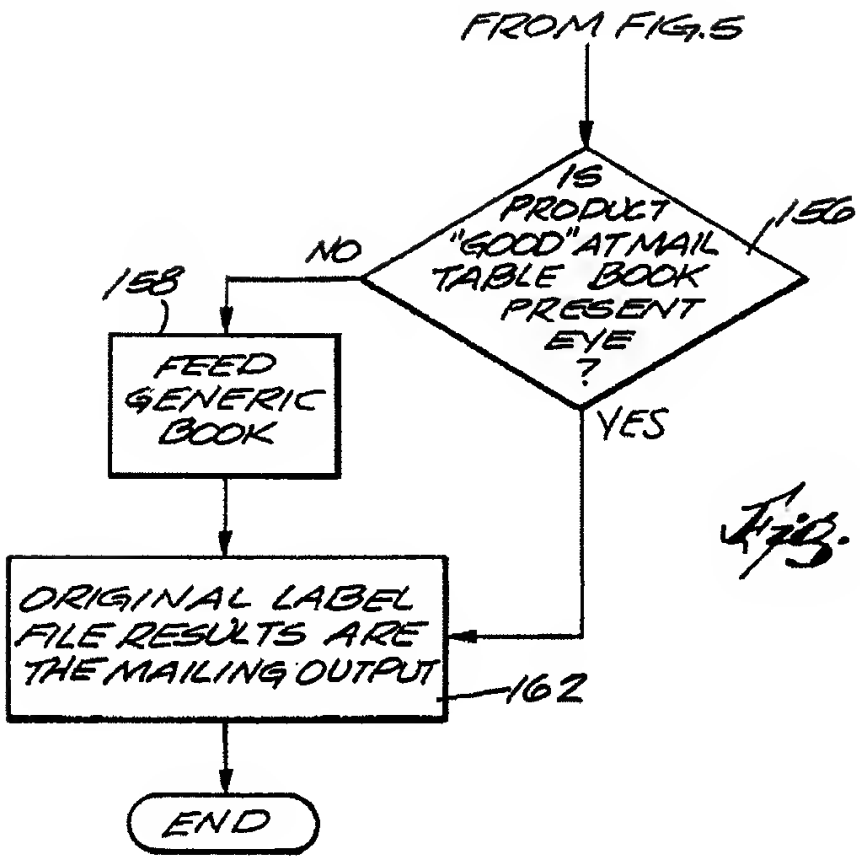
FROM FIG. 5
IS PRODUCT "GOOD" AT MAIL TABLE BOOK PRESENT EYE ?
156
NO
158
FEED GENERIC BOOK
YES
ORIGINAL LABEL FILE RESULTS ARE THE MAILING OUTPUT
162
END

Fig. 6

APPARATUS FOR SELECTIVE WRAPPING OF PRODUCTS AND A METHOD THEREOF

FIELD OF THE INVENTION

The present invention relates, generally, to an apparatus and a method for wrapping selected products found in a stream of a plurality of products. More particularly, the present invention relates to an apparatus and a method which combines a binding or stitching operation and a wrapping operation into a single operation which divides the stream of products into at least two additional streams of products, i.e., a stream of products to be wrapped and a stream of products not to be wrapped, whereafter the divided streams of products are merged again into a single stream of products in a desired output order, such as demographic order.

BACKGROUND OF THE INVENTION

During the processing of magazines, newspapers, books, periodicals or other sheet material products or articles, it is sometimes desirable to wrap selected articles with, for example, paper or conventional hand wrapping or plastic film which may be a polymeric or polyethylene plastic film. There are many different reasons for selectively wrapping certain articles from a series of articles. This flexibility is important in satisfying the demands of a particular market or geographical destination. For instance, it may be desirable to offer certain customers or subscribers various features or selected advertising depending upon their special interest, income or occupation. Likewise, it may be relevant to customize products or services contingent upon a customer's previous buying history. For example, a publication may issue one demo edition for parents of newborn children who have previously purchased baby products, another edition for farmers interested in the latest agricultural equipment and still another edition for recent purchasers of exercise equipment. In each situation, a publisher may utilize various modes of customization such as blown-in card feeding, invoicing, advertising material insertion, renewal notices and tipping, as well as several types of contact or contactless printing. As a result, it is usually desirable to wrap the products including one or more of these items in order to enclose such loose items.

It is generally understood that magazines or other products can be packaged in such a way so as to take maximum advantage of postal discounts. For example, grouping a certain number of products and sending these products to subscribers having a common five-digit zip code in the same carrier route, qualifies the packages for a lower postal rate thereby saving the publisher money. Therefore, it is preferred that a bindery output articles in an order that facilitates sorting and packaging to maximize postal discounts.

Currently, collation and binding (conveyor) lines for stitchers build magazines, catalogues, brochures, periodicals, etc. in an order that facilitates sorting and packaging so as to receive such postal discounts. Each product binding line typically comprises an inserter having a plurality of signature feeders, a collating chain or conveyor, a customizing station, a stitcher, a trimmer, a labeling station, a bad book conveyor, a stacker and a strapper, as known to those skilled in the art. Once products are assembled and packaged in a desired order, the products are typically delivered to a Post Office for continued delivery to their final destination. So as not to create a slowdown in the overall production of the products, wrapping lines are generally separate and apart from binding lines. As previously pointed out, it is sometimes desirable to customize

products with certain advertising or promotional material. It is also sometimes desirable to preserve the appearance of products. Customizing certain products with additional material or protecting certain products from damage requires that these products be wrapped with a protective wrapping. Wrapping machines conventionally apply a transparent polywrap material or paper wrap material or band wrap material around each individual product sent through a respective wrapping line. Like the binding lines, the wrapping lines output the products in an order that facilitates sorting and packaging so as to also enable certain postal discounts.

One problem with separate and distinct binding and wrapping lines is that bundles of products produced by each separate line are delivered to the appropriate Post Office and these bundles typically have overlapping zip codes thereby not fully utilizing the overall savings that could be realized through postal discounts. Therefore, it would be beneficial to provide an apparatus and a method which are capable of combining a binding line and a wrapping line so as to maximize postal discounts by eliminating such overlapping zip codes. However, because the production processes between a binding line and a wrapping line are not generally compatible, combining these two systems into a single system has heretofore been difficult to accomplish. As a result, bundles from binding lines and wrapping lines are often manually combined together to eliminate overlapping zip codes. However, this manual operation is generally unacceptable because any postal discounts achieved by packaging the products according to matching zip codes are outweighed by the expenses associated with the manual labor needed to organize the bundles.

SUMMARY OF THE INVENTION

Accordingly, the present invention provides the advantage of conveniently and efficiently combining a binding line with a wrapping line to eliminate the need for separate and distinct binding and wrapping operations thereby reducing manufacturing and labor costs while at the same time maximizing postal discounts. The present invention also provides an apparatus and a method which offer a greater degree of product customization. Further, the present invention provides an apparatus and a method which selectively wrap individual products found in a stream of products and yet are also capable of combining the wrapped and unwrapped products into a desired output so as to maximize postal discounts.

In one aspect, the present invention provides an apparatus for wrapping selected products of a plurality of products. The products are assembled on a conveyor line according to coded information. The plurality of products continuously moves in a stream of products toward a packaging assembly which is operatively connected to the conveyor line. A deflecting device positioned along the stream of products divides the stream of products into at least two additional streams of products. The present invention contemplates selectively diverting certain products according to coded information either to a wrapping line where products are wrapped or to a non-wrapping line where products are not wrapped. The present invention further contemplates merging the wrapped products and non-wrapped products in another conveyor line according to a predetermined output order whereafter the stream of products is delivered to packaging equipment before shipment to a Post Office.

The present invention may be further characterized in that a control system is adapted to receive coded information of

each product to be produced prior to the start of the manufacturing process. The control system processes the coded information to determine which products of the plurality of products require wrapping. Based on the desired final demographic output order and based upon the information as to which products out of the plurality of products require wrapping, the control system determines the order of assembly for each of the plurality of products. The control system then communicates with the appropriate components of the binding operation and the packaging operation in order to ensure that the proper output order of products is obtained.

The present invention may also be characterized in that the wrapping line comprises a pre-buffer zone, a wrapping device and a post-buffer zone. The deflecting device moves the selected products to be wrapped to the pre-buffer zone of the wrapping line. A predetermined number of products are collected in the pre-buffer zone before such products are delivered to the wrapping device. According to one aspect of the present invention, products to be wrapped are continuously fed to the wrapping device so as to improve the overall operation of the wrapping device. The pre-buffer zone is adapted to collect and feed products to the wrapping device to ensure a continuous translation of products to be wrapped. The post-buffer zone collects the wrapped products prior to delivering the wrapped products to a further destination.

According to another aspect of the present invention, the wrapping line is designed to feed wrapped products to a downstream conveyor line such that the wrapped products merge or commingle with the unwrapped products which were diverted into the non-wrapping line. In this manner, the present invention allows wrapped products to join up with non-wrapped products to output a predetermined order of the products.

The present invention also relates to a method for selectively wrapping certain products of a stream of products according to coded information The method includes inputting coded information into a control system which processes the information to determine which products require wrapping. The method further includes generating an order of assembly for the products taking into account the filling of the pre and post-buffer zones such that the output of the products will be in a desired order, such as demographic order. The method also includes continuously moving the stream of products along a first path and dividing the stream of products into at least two additional streams of products, one containing those products to be wrapped and the other containing those products not to be wrapped. The method incorporates a manner of merging the two additional streams of products back into a combined stream whereby the products are arranged in the predetermined output order as originally inputted to the control system.

It is therefore a feature of the present invention to provide an apparatus and a method which contain the features and advantages set forth herein and which are much simpler in design.

It is another feature of the present invention to provide an apparatus and a method which improve the customizing capability for high speed demographic binders and wrappers. Specifically, according to the present invention, prior separate binding and wrapping operations can now be combined into a single processing operation which allows for selective wrapping of certain products and an output of products which contains wrapped and unwrapped products and, yet, which also maximizes postal discounts.

It is yet another feature of the present invention to provide an apparatus and method which allow for selective wrapping of products from a plurality of products and which are particularly versatile and capable of improving existing systems.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims, and drawings in which like numerals are used to designate like features.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top elevational view of a processing line for practicing a method embodying the present invention.

FIGS. 2–6 are flow charts illustrating the selective wrapping process embodying the present invention.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The use of "consisting of" and variations thereof herein is meant to encompass only the items listed thereafter and equivalents thereof. The use of letters to identify steps of a method or process is simply for identification and is not meant to indicate that the steps should be performed in a particular order.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in FIG. 1 is an in-line processing system **10** according to the present invention for processing products or articles which may include newspapers, magazines, books or the like. The processing system **10** includes a stitcher controller or assembly controller **12**, an assembly line **14**, a binder or stitcher **16**, a trimmer **18**, a gripper conveyor **20** which conveys products from the trimmer **18** to an in-feed conveyor **22** or a drop table **24**, a wrapping assembly **26** which includes a pre-wrapper accumulating conveyor **28**, a wrapper **30**, a post-wrapper accumulating conveyor **32**, and a wrapper controller **34**, a wrapper bypassing conveyor **36** which conveys selected products from the in-feed conveyor **22** to a mail table **38**, and further processing equipment such as packaging equipment **40**. Various inkjet units, printer feeders, feeder pockets and product diverters may be positioned at various places along the processing system **10** as needed and/or as desired as will be further discussed below. The processing system **10** according to the present invention combines an assembly operation **42** with a packaging operation **44** in a single in-line processing system **10** which provides an output stream of products destined for delivery to, for example, a United States Post Office.

A feature of the system **10** is the system's capability to individually wrap selected products. A product may be individually wrapped if, for example, the product such as a magazine is the first issue going to a customer or subscriber and an invoice is to be included in the wrapping. Other products may not have to include an invoice and, therefore, they would not have to be wrapped. If a product is not to be wrapped, the product is picked up by the wrapper bypassing conveyor **36** which bypasses the wrapping assembly **26** and drops the products off at the mail table **38**. Those products

that are intended to be wrapped are sent on to the wrapping assembly 26. The products to be wrapped are held in the pre-wrapper accumulating conveyor 28 until a predetermined sufficient number of products have been collected. After a certain number of products have been accumulated in the pre-wrapper accumulating conveyor 28, the products are passed to the wrapper 30 for individual wrapping. After the products are wrapped, the products are transported to the post-wrapper accumulating conveyor 32. The products are then held within the post-wrapper accumulating conveyor 32 until such time as the products join up and merge with the bypassed products traveling along the wrapper bypassing conveyor 36 at the mail table 38 in order to produce the desired output order. A feature of the present invention is to allow selective wrapping of certain products and output a combined desired order of wrapped and non-wrapped products.

To further illustrate the present invention, the invention will now be described with reference to the flow chart shown in FIGS. 2–6 in conjunction with the apparatus shown in FIG. 1. Any reference to a piece of equipment in the processing system 10 will be shown in FIG. 1. Any reference to a Box will correspond to a process step found in the flow chart depicted in FIGS. 2–6.

To begin, a label file, comprising, for example, subscriber names, codes, addresses, messages, etc., is downloaded or inputted to the stitcher controller 12 (Box 46). The label file includes information which corresponds to each particular article or product of a set of products to be processed by the system 10. Generally, the label file includes: coded information (a product build descriptor) designating the particular feeders to be activated along the binding line 14 to build each product (i.e., the particular component signatures of the product); indicia of the identity and address of the subscriber for which each product is being assembled; and customization information, e.g., a particular message to be printed in each product, actuation indicia for a card inserter, an application device or the like. Such customization information may also include a coded designation (product selection control field) identifying products for which customized packaging is to be effected, e.g., the particular onsert dispensing units to be actuated, and when printers or inkjet units are to be employed.

The inputted label file is referred to as the original label file. The label file is downloaded to the stitcher controller 12 in a particular order which preferably represents the desired output order of the products to be processed by the system 10. In other words, the products can be received by the mail table 38 and sent on to the packaging equipment 40 according to the order set forth in the original label file. The label file may be downloaded to the stitcher controller 12 in any number of proven ways such as, for instance, a magnetic tape or diskette or through any other known electronic means. Importantly, the label file includes an identifier for each product that requires wrapping. The stitcher controller 12 may be any type of suitable controller commonly known to those skilled in the art, such as an FCS 1000 or an FCS 2000 inkjet controller from Quad/Tech, Inc., of Sussex, Wis., which is particularly suited for use according to the present invention.

After the stitcher controller 12 receives the original label file, the wrapper controller 34 scans the original label file searching for the wrapper identifiers in order to determine which products require wrapping. The wrapper controller 34 may also be any type of suitable controller commonly known to those skilled in the art. However, the controllers identified above and available from Quad/Tech are particularly suited for use according to the subject invention. The stitcher controller 12 and the wrapper controller 34 should be capable of electronically communicating with each other. As the wrapper controller 34 scans the original label file found within the stitcher controller 12, the wrapper controller 34 creates a sister label file (Box 48). The sister label file contains the information for those products from the original label file that are intended to be wrapped.

After the wrapper controller 34 generates the sister label file, the wrapper controller 34 also generates a running file which sequentially lists the order of the products as they will be assembled in the assembly line 14 (Box 50). As will be further explained below, the running file takes into account the accumulation of the products in the pre and post-buffer zones. Thus, preferably, the order of the products in the running file does not correlate with the order of the products in the original label file. Once the running file is generated and the wrapper controller 34 communicates with the stitcher controller 12, the manufacturing process begins (Box 52).

The stitcher controller 12 controls the assembly process of the individual products as the products travel through the assembly operation 42. The first part of the manufacturing process includes assembling the products in the assembly line 14 which is made up of a collation line and/or a binding line as shown in FIG. 1. The products are assembled in the assembly line 14 according to the order set forth in the running file.

One or more printer feeders 54 may be positioned along the assembly line 14 in order to selectively feed inserts/onserts such as invoices, promotional material etc. within selected products or magazines as is well known in the art. One or more inkjet units or printers 56 may also be positioned along the assembly line 14 to selectively print on individual signatures as the signatures travel past the inkjet units 56 as is also well known in the art. Data from the original label file will identify which products receive inserts/onserts or selective printing. The stitcher controller 12 will electronically communicate with the printer feeders 54 and/or inkjet units 56 and/or other similar devices to identify when selective inserting/onserting or printing is desired for a given product being assembled.

After individual signatures are assembled into collated products, the products are bound by a binder or stitcher 16. Once bound, the individual products are sent through the trimmer 18. As generally understood by those skilled in the art, the trimmer 18 functions to trim or cut excessive material from each product and attempts to square one page of the product to the next.

After the trimmer 18, a sensor assembly 59 is properly positioned at or around reference numeral 60 so as to determine if each product is acceptable to continue on through the processing system 10 (Box 62). The sensor of the sensor assembly, also called a short book eye, may be an electronic sensor, an infra-red sensor or any other type of sensor in which, preferably, an emitter and a receiver are utilized. If after being trimmed, a product is not properly squared or is too short or is too long for example, the sensor assembly 59 will indicate that the product is unacceptable to continue on through the processing system 10. Typically, the sensor assembly operates in such a manner that if the emitter and the receiver of the sensor assembly are blocked at the same time, the product is usually acceptable. If the sensor eyes are not blocked at the same time, the product is usually not in a condition to continue.

If the product is acceptable at sensor assembly 59, a signal is sent by the sensor assembly 59 to the stitcher controller 12

so that a divert gate (not shown) positioned along the trimmer line 64 at or around reference numeral 66 is opened and the product is directed into the gripper conveyor 20 or gripper conveyor 1 so that the product can continue on through the processing system 10 (Box 68). If the product is not acceptable at sensor assembly 59, a signal is sent by the sensor assembly 59 to the stitcher controller 12 so that the divert gate is closed and the product is removed from the processing system 10 by suitable reject mechanisms (not shown) (Box 70). The stitcher controller 12 electronically communicates with the divert gate instructing the gate to open or close as needed.

There are many different configurations of assembly lines, printer feeders, inkjet units, stitchers, trimmers, sensors and divert gates known to those skilled in the art which are readily available from numerous commercial sources and which are capable for use according to the principles of the present invention. The manner of assembling, inserting, printing, binding and trimming the products is well known in the art and does not independently play a significant part of the present invention.

It should be noted that the assembly operation 42 may be monitored for the occurrence of errors in any number of known ways. Sensors or encoders may be located at strategic locations in the assembly operation 42 and/or packaging operation 44 to sense the presence of acceptable or unacceptable products. The controllers 12 and 34 will communicate with the appropriate mechanisms to remove an unacceptable product at a chosen location.

Continuing on through the system 10, products that pass the divert gate in the trimmer line 64 are picked up by the gripper conveyor 20 which connects the assembly operation 42 with the overall packaging operation 44. The gripper conveyor 20 may be any type of conveyor suitable for use according to the principles of the present invention, which is generally known to those skilled in the art and readily available from numerous commercial sources. However, a single-copy gripper conveyor such as a NP-200 available from Heidelburg Finishing Systems, Inc., of Dayton, Ohio, is suitable for use according to the present invention. At this point, products will continue on through the system 10 either backbone/spine leading or head/foot leading through the remainder of the system 10. The original label file contains coded information which will inform the stitcher controller 12 whether the products in a set of products will travel backbone/spine leading or head/foot leading through the packaging operation 44. Based upon this information, the stitcher controller 12 will instruct the gripper conveyor 20 as to how the products will continue on through the system 10 (Box 72).

Preferably, for a given set of products, all of the products will either run backbone/spine leading or head/foot leading through the packaging operation 44, not a combination of the two. As shown, the gripper conveyor 20 either drops the products off at point A or point B. If the products are to travel head/foot leading through the system 10, the products are dropped off at point A on the drop table 24 (Box 74). If the products are to travel backbone/spine leading through the system 10, the products are dropped off at point B on the in-feed conveyor 22 (Box 76). The drop table 24 may be a lugged conveyor generally known to those skilled in the art and commercially available from numerous sources. The in-feed conveyor 22 may be any type of conveyor suitable for use according to the principles of the present invention, such as a lugged conveyor of the same type as the drop table 24.

As the products travel along the in-feed conveyor 22, it must be determined whether a product is intended to be wrapped or not (Box 78). The sister label file identifies which products in the stream of products are destined for the wrapper 30. The wrapper controller 34 tracks the position of each product moving along the in-feed conveyor 22 by preferably employing a conventional encoder 79 positioned along the conveying line 22. The wrapper controller 34 will instruct the wrapper bypassing conveyor 36 which products to take possession of out of the stream of products and which products to let pass. Although not shown, a divert gate may be positioned at or around reference numeral 77 to direct those products not destined for the wrapper 30 into the wrapper bypassing conveyor 36.

If a product is not intended to be wrapped, that product is picked up by the wrapper bypassing conveyor 36. If a product is intended to be wrapped, that product is directed toward the wrapping assembly 26 (Boxes 80 and 82). Those products directed into wrapper bypassing conveyor 36 or gripper conveyor 2 will eventually be delivered to the mail table 38 as will be further explained below. The wrapper bypassing conveyor 36 may be any type of conveyor suitable for use according to the principles of the present invention. However, a conveyor like gripper conveyor 20 is suitable for use according to the present invention.

The first portion of the wrapper assembly 26 includes a first diverting conveyor 84, the pre-wrapper accumulating conveyor 28, and a second diverting conveyor 86. The pre-wrapper accumulating conveyor 28 or accumulating conveyor number 1 preferably includes at least two tiers, a top conveyor tier 88 and a bottom conveyor tier 90. The purpose of providing at least two tiers will be more fully explained below. It is contemplated that the pre-wrapper accumulating conveyor 28 comprises an indexing conveyor which cooperates with a clutch assembly in order to index or advance a cell or a slot one cell at a time as needed, or when a product is set to be delivered to the conveyor 28. The first diverting device or diverting conveyor 84 is located directly upstream of the pre-wrapper accumulating conveyor 28. The diverting conveyor 84 directs products into one or the other of the tiers 88 and 90 depending on which tier 88 or 90 is accepting products.

Located directly downstream of the pre-wrapper accumulating conveyor 28 is the second diverting device or diverting conveyor 86. This diverting conveyor 86 conveys products from one or the other of the tiers 88 and 90 into the second portion of the wrapper assembly 26 or wrapper 30 depending on which tier 88 or 90 is emptying products. The diverting devices may be of any commonly known diverting assemblies but diverting conveyors designed to separate a single stream of products into a plurality of streams of products or to combine a plurality of streams of products into a single stream of products are particularly suitable for use according to the principles of the present invention. The overall cooperation between the diverting conveyors 84 and 86, pre-wrapper accumulating conveyor 28 and the wrapper 30 will be more fully set forth below.

In a typical manufacturing process, products are assembled, bound and trimmed at a rate of around 200–300 products per minute. The speed of the stitcher 16 or assembly operation 42 generally determines the rate at which products are assembled, bound and trimmed. The gripper conveyor 20, the drop table 24, the in-feed conveyor 22, the wrapper bypassing conveyor 36, the diverting conveyor 84, the diverting conveyor 92 (described below), and the mail table 38 preferably operate at the same speed as the stitcher 16 or assembly operation 42. Preferably, the speed of the tier 88 or 90 accepting products coincides with the speed of the stitcher 16 or assembly operation 42 (Box 94). In this way,

successive products entering the appropriate tier 88 or 90 will not collide with each other. If collision were to occur, this could cause the entire system 10 to jam up which would require the system 10 to be shut down in order to clear away the jam.

As will be further explained, only one tier 88 or 90 is adapted to accept products at any given time. Wrapper controller 34 sends a signal to diverting conveyor 84 instructing the diverting conveyor 84 as to which tier 88 or 90 it should direct products. Products destined for the wrapper 30 are fed into the selected tier 88 or 90 for so long as the selected tier 88 or 90 has additional accumulating space (Box 96). As the tier 88 or 90 accepts products, the tier 88 or 90 will index to the next open cell until the tier 88 or 90 is full (Box 98). A scanner, such as a scanner which utilizes an emitter and a receiver which is generally known to those skilled in the art and readily available from numerous commercial suppliers, may be appropriately positioned along the pre-wrapper accumulating conveyor 28 in order to send a signal to the wrapper controller 34 when the tier 88 or 90 accepting products is full.

Upon learning that the tier 88 or 90 accepting products is full, the wrapper controller 34 sends a signal to the diverting conveyor 84 instructing the diverting conveyor 84 to direct the next line of products into the other or empty tier 88 or 90 (Box 100). This previously empty tier 88 or 90 continues to accept products for so long as it has additional accumulating space or until full and then the diverting conveyor 84 shifts again in the same manner as above so as to divert the next line of products into the other or now empty tier 88 or 90. Preferably, as one tier 88 or 90 is accepting products, the other tier 88 or 90 is emptying products into the wrapper 30.

Once tier 88 or 90 is full and a signal has been sent to the wrapper controller 34, the wrapper controller 34 sends a signal to the full tier 88 or 90 to change the speed of the full tier 88 or 90 to follow the speed of the wrapper 30 (Box 102). For the same reasons that the tier 88 or 90 that is accepting products should travel at the same speed as the stitcher 16 or assembly operation 42, the tier 88 or 90 feeding products to the wrapper 30 should travel at the same speed as the wrapper 30. Generally, a wrapper 30 will not travel as fast as a stitcher 16 or assembly operation 42. Thus, the tiers 88 and 90 of the pre-wrapper accumulating conveyor 28 are preferably independently driven to travel at different speeds since the wrapper 30 generally works at a different speed than assembly operation 42.

Once the speed of the full tier 88 or 90 has been changed to match that of the wrapper 30, the full tier 88 or 90 is set to deliver products to the wrapper 30 and the wrapping process can begin (Box 104). The wrapper 30 may be any type of wrapper known to those skilled in the art which is compatible with the principles of the subject invention. The wrapper 30 generally applies a transparent plastic film or paper wrap or band wrap, etc., around each product sent to the wrapping assembly 26. The wrapper 30 should be capable of enveloping, severing, heating and sealing a plastic-like or paper-like protective film or packaging around each product. One such wrapper which is suitable for use according to the present invention is a L80-750 poly-wrapper, available from Sitma U.S.A. Corp., of St. Paul, Minn.

A feature of the present invention is to send a number of products through the wrapper 30 one after the other rather than intermittently send the products through a wrapper. The plastic film wrapping material used by a wrapper can be difficult to control, as can be appreciated by those skilled in the art. The wrapping material is very thin and extremely flimsy. As such, it is desirable to control the tension of the wrapping material. A continuous wrapping operation or at least a wrapping operation which operates to wrap sets of a plurality of products in a continuous manner leads to better control over the wrapping material versus an intermittent operation. Also, wrappers generally use knives to cut the wrapping material and heaters to heat the film or plastic or adhesive it utilizes so as to seal the wrapping material. The temperature of the knives and heaters affects the overall operation of a wrapper operating a wrapper continuously or at least for periods of continuous operation allows for better control over the temperatures of the knives and heaters thereby further enhancing the operation of a wrapper.

Positioned along the wrapper line 106 and/or the wrapper bypassing line 108 may be one or more inkjet units 110 and/or one or more printer feeders 112 similar to those previously described with reference to the assembly line 14. Additionally, feeder pockets 114 may also be positioned along the wrapper line 106. Feeder pockets 114 are generally known to those skilled in the art and are readily available from numerous sources. The inkjet units 110 and/or printer feeders 112 can personalize a product with an insert or an onsert such as an invoice. The feeder pockets 114 can also personalize a product with an insert or an onsert such as a promotional product which may include a CD-ROM disk or the like. When placing an insert in or an onsert on a particular product, it is important to place the insert or the onsert in the correct position in or on the product. An improperly placed insert or onsert may adversely affect the wrapping process as can be appreciated by those skilled in the art.

The continuous wrapping process according to the present invention helps maintain the proper placement of an insert or an onsert versus the stop-and-go wrapping method of the prior art. As known in the art, some of the coatings found on certain products such as magazines are shinny and/or slippery. If an insert or an onsert such as a CD-ROM disk is placed in or on a product, the intermittent motion of prior art wrapper systems can cause the insert or the onsert to be shaken off of or out of the product or at least slid from the original position. The smooth continuous process of the wrapper 30 according to the present invention minimizes the undesirable results of an insert or an onsert falling off of or out of a product or from shifting to an undesirable location on or in the product.

The tier 88 or 90 delivering products to the wrapper 30 continues to deliver products to the wrapper 30 until such time as that tier 88 or 90 is empty (Box 116). Once the tier 88 or 90 is completely emptied, a scanner, like the scanner previously described in reference to indicating when tier 88 or 90 is full, may be appropriately positioned along the pre-wrapper accumulating conveyor 28 in order to send a signal to the wrapper controller 34 such that the wrapper controller 34 changes the speed of the now emptied tier 88 or 90 back to the speed of the stitcher 16 or assembly operation 42 so that the now emptied tier 88 or 90 is ready to accept products once the other tier 88 or 90 is full (Box 118).

As noted, as the products make their way through the wrapper 30, the products may undergo selective inserting, onserting or printing (Box 120). This information is controlled by the information contained within the original label file and copied to the sister label file (Box 122). After the wrapper 30 wraps the product and the film is sealed by the wrapper 30 at a seal bar section 124, the products are directed through an accelerator section 126 and towards the

post-wrapper accumulating conveyor 32 or accumulating conveyor number 2 (Box 128).

The post-wrapper accumulating conveyor 32 is a part of a third portion of the wrapper assembly 26 which also comprises a first diverting conveyor 130 and the second diverting conveyor 92. The post-wrapper accumulating conveyor 32 is similar to the pre-wrapper accumulating conveyor 28, and, therefore, the post-wrapper accumulating conveyor 32 preferably includes at least two tiers, a top conveyor tier 132 and a bottom conveyor tier 134. The pair of diverting conveyors 130 and 92 cooperate with the post-wrapper accumulating conveyor 32. Preferably, whichever tier 88 or 90 of the pre-wrapper accumulating conveyor 28 is feeding product to the wrapper 30, the diverting conveyor 130 will direct product into the corresponding top 132 or bottom 134 tier of the post-wrapper accumulating conveyor 32. Whichever tier 132 or 134 is being filled, the speed of that tier 132 or 134 as controlled by the wrapper controller 34 will match that of the wrapper 30 (Box 136). The tier 132 or 134, accepting products will continue to accept products, for so long as the selected tier 132 or 134 has additional accumulating space (Box 138). As the tier 132 or 134 accepts products, the tier 132 or 134 will index to the next open cell until the tier 132 or 134 is full (Box 140).

A scanner such as the scanners described in reference to the pre-wrapper accumulating conveyor 28 may be properly positioned along the post wrapper accumulating conveyer 32 to send a signal to the wrapper controller 34 when the tier 132 or 134 accepting products is full. Upon learning that the tier 132 or 134 is full, the wrapper controller 34 sends a signal to the diverting conveyor 130 instructing the diverting conveyor 130 to direct the next line of wrapped products into the other or empty tier 132 or 134 (Box 142). This previously empty tier 132 or 134 continues to accept product for so long as it has additional accumulating space or until full and then the diverting conveyor 130 shifts again in the same manner as above so as to divert the next line of products into the other or now empty tier 132 or 134. Preferably, as one tier 132 or 134 is accepting product, the other tier 132 or 134 is emptying product as will be further explained.

Once tier 132 or 134 is full and a signal has been sent to the wrapper controller 34, the wrapper controller 34 sends a signal to the full tier 132 or 134 to change the speed of the full tier 132 or 134 to follow the speed of the stitcher 16 or assembly operation 42 (Box 144). The full tier 132 or 134 is now ready to deliver products to the mail table 38 (Box 146). As should be apparent, tiers 132 and 134 are preferably independently driven.

Until the full tier 132 or 134 is empty (Box 148), the tier 132 or 134 selectively delivers product to the mail table 38 to fill the empty slots found in the stream of products as the wrapper bypassing conveyor 36 delivers product to the mail table 38 (Box 150). The merging of the products from the wrapper bypassing conveyor 36 and the wrapper 30 at the mail table 38 will be further explained below with reference to the example provided herein. Once the tier 132 or 134 is empty, preferably a signal is sent to the wrapper controller 34 by a scanner similar to those provided for above, so that the wrapper controller 34 can change the speed following command of the now empty tier 132 or 134 to return to that of the wrapper 30 for the reasons stated above (Box 152).

The mail table 38 is similar to the in-feed conveyor 22 but may be any type of conveyor suitable for use according to the present invention. The products will be processed along the mail table 38 preferably according to the order sent forth in the original label file. That is, preferably, the wrapped products that travel through the wrapper assembly 26 and the unwrapped products which bypass the wrapper assembly 26 by traveling along the wrapper bypassing conveyor 36, are combined at the mail table 38 according to the order of the original label file. Once the products reach the mail table 38, a sensor assembly, like the sensor assembly positioned along the trimmer line 64, may be properly positioned at or around reference numeral 154 so as to determine if each product is acceptable to be packaged for mailing (Box 156). Although not shown, a sensor like the one just mentioned may be appropriately placed along the wrapper line 106 to determine if each product should continue on or be removed from the processing system 10 consistent with the teachings of the present invention.

If the product is acceptable at the mail table 38, the product continues on to the packaging equipment 40. If the product is unacceptable, the product is diverted out of the processing system 10 and a generic or replacement product is fed in its place (Box 158). A generic product or book feeder 160 known to those skilled in the art is positioned along the mail table 38 to feed a generic product when necessary. Although not shown, a generic product feeder may be appropriately placed along the trimmer line 64 or any other suitable position to feed a generic product if a product is diverted from the system 10. The original label file results will coincide with the mailing output even if a generic product is needed (Box 162).

Although not shown, inkjet units, printer feeders and/or feeder pockets may be positioned along the mail table 38 if desired. In fact, such equipment may be placed anywhere along the system 10 depending on the output desired. Typically, the final delivery address is placed on the product along the mail table 38 but can be placed on the inside of the wrapping material so that a delivery person can look through the wrap to find the address.

Having described the overall apparatus and method according to the present invention, to further illustrate the invention, a method according to the invention is described with reference to Tables I–III. In this example, the product series comprises 200 magazines. Table I consists of the Original Label File for 200 magazines and the information which is downloaded to the stitcher controller 12 (Box 46) where:

S#=Sequence Number of Magazine;

WI=Wrap Indicator, where 0 indicates that the magazine is not to be wrapped and 1 indicates that the magazine is to be wrapped;

BT=Book Type which may be identified with numbers 1–6 identifying various Book Types customized to particular customers; and

WBT=Wrapped Book Type which may be identified with letters A–D identifying various Wrapped Book Types customized to particular customers; 0 indicates the magazine is not to be wrapped.

TABLE I

ORIGINAL LABEL FILE

S#	WI	BT	WBT	S#	WI	BT	WBT	S#	WI	BT	WBT	S#	WI	BT	WBT
1	0	4	0	51	0	2	0	101	1	1	5	151	0	2	0
2	0	2	0	52	1	5	C	102	0	3	0	152	0	2	0
3	0	2	0	53	0	3	0	103	0	2	0	153	1	5	B
4	1	1	D	54	0	4	0	104	0	4	0	154	0	3	0
5	0	4	0	55	0	4	0	105	0	4	0	155	0	3	0
6	0	4	0	56	0	3	0	106	0	3	0	156	0	2	0
7	0	4	0	57	0	3	0	107	0	4	0	157	0	2	0
8	0	3	0	58	1	1	C	108	0	4	0	158	1	1	D
9	0	2	0	59	1	1	B	109	0	3	0	159	0	3	0
10	0	3	0	60	1	1	B	110	0	2	0	160	0	4	0
11	1	5	C	61	1	6	D	111	0	2	0	161	0	4	0
12	0	3	0	62	0	3	0	112	1	1	A	162	1	1	A
13	0	4	0	63	0	2	0	113	0	3	0	163	0	4	0
14	0	4	0	64	0	4	0	114	0	4	0	164	0	2	0
15	1	6	B	65	0	4	0	115	0	4	0	165	0	4	0
16	0	4	0	66	0	3	0	116	0	4	0	166	0	4	0
17	0	2	0	67	1	1	B	117	1	5	B	167	1	1	C
18	0	3	0	68	0	3	0	118	0	3	0	168	0	3	0
19	0	3	0	69	0	2	0	119	0	3	0	169	0	3	0
20	0	3	0	70	0	2	0	120	0	2	0	170	0	3	0
21	0	3	0	71	1	1	C	121	0	3	0	171	0	2	0
22	0	2	0	72	0	2	0	122	0	4	0	172	1	1	C
23	0	2	0	73	0	4	0	123	0	2	0	173	0	3	0
24	0	4	0	74	0	4	0	124	1	1	D	174	0	4	0
25	1	1	A	75	1	5	A	125	0	3	0	175	1	1	A
26	0	3	0	76	0	2	0	126	0	3	0	176	0	2	0
27	0	2	0	77	0	3	0	127	0	2	0	177	0	4	0
28	0	2	0	78	0	2	0	128	0	2	0	178	1	6	D
29	1	1	C	79	0	3	0	129	0	2	0	179	0	4	0
30	0	3	0	80	0	2	0	130	1	1	C	180	1	1	C
31	0	3	0	81	0	3	0	131	0	3	0	181	0	3	0
32	0	4	0	82	0	3	0	132	0	3	0	182	0	2	0
33	0	4	0	83	0	3	0	133	0	3	0	183	0	2	0
34	0	4	0	84	1	5	C	134	1	1	B	184	0	2	0
35	0	3	0	85	0	3	0	135	0	3	0	185	0	2	0
36	0	4	0	86	1	1	C	136	0	4	0	186	0	2	0
37	1	6	D	87	0	4	0	137	0	4	0	187	0	4	0
38	0	2	0	88	1	1	B	138	1	5	C	188	0	3	0
39	0	2	0	89	0	2	0	139	0	3	0	189	0	4	0
40	0	2	0	90	0	3	0	140	0	2	0	190	1	1	D
41	0	3	0	91	0	3	0	141	0	4	0	191	0	2	0
42	1	6	D	92	0	3	0	142	0	3	0	192	0	4	0
43	0	3	0	93	0	4	0	143	0	3	0	193	0	2	0
44	0	4	0	94	1	6	C	144	0	2	0	194	1	6	B
45	0	3	0	95	0	2	0	145	0	4	0	195	0	3	0
46	0	3	0	96	0	2	0	146	1	1	D	196	0	3	0
47	0	3	0	97	0	2	0	147	1	6	C	197	0	2	0
48	0	4	0	98	0	4	0	148	0	3	0	198	1	1	D
49	1	1	B	99	0	3	0	149	0	2	0	199	0	3	0
50	0	3	0	100	0	4	0	150	0	2	0	200	0	2	0

It should be noted that the original label file may contain additional data regarding each product than that shown.

Table II consists of the Sister Label File generated by the wrapper controller 34 (Box 48) where:

S#'=Sister Label Sequence Number of Magazine;

WBT=Wrapper Book Type; and

(OSN)=Original Sequence Number (S#) from the Original Label File.

TABLE II

SISTER LABEL FILE

S#'	WBT	(OSN)	S#'	WBT	(OSN)	S#'	WBT	(OSN)	S#'	WBT	(OSN)
1	D	(4)	11	B	(59)	21	B	(101)	31	D	(158)
2	C	(11)	12	B	(60)	22	A	(112)	32	A	(162)
3	B	(15)	13	D	(61)	23	B	(117)	33	C	(167)
4	A	(25)	14	B	(67)	24	D	(124)	34	C	(172)
5	C	(29)	15	C	(71)	25	C	(130)	35	A	(175)
6	D	(37)	16	A	(75)	26	B	(134)	36	D	(178)

TABLE II-continued

SISTER LABEL FILE

S#'	WBT	(OSN)	S#'	WBT	(OSN)	S#'	WBT	(OSN)	S#'	WBT	(OSN)
7	D	(42)	17	C	(84)	27	C	(138)	37	C	(180)
8	B	(49)	18	C	(86)	28	D	(146)	38	D	(190)
9	C	(52)	19	B	(88)	29	C	(147)	39	B	(194)
10	C	(58)	20	C	(94)	30	B	(153)	40	D	(198)

As explained, the sister label file identifies which magazines from the original label file are intended to be wrapped. Thus, forty out of the original 200 magazines are intended to be wrapped.

Table III contains the running file generated by the wrapper controller **34** (Box **50**) where:

RFS#=Running File Sequence Number of Magazine;

PFS#=Pre-running File Sequence Number of Magazine [i.e., S# or (S#')]; and

OP#=Output Number of Magazine, which corresponds to the original sequence number (S#) from the Original Label File.

TABLE III

RUNNING FILE

RFS#	PFS#	OP#	RFS#	PFS#	OP#	RFS#	PFS#	OP#	RFS#	PFS#	OP#
1	(1)	4	51	31	31	101	81	81	151	137	137
2	(2)	11	52	32	32	102	82	82	152	139	139
3	(3)	15	53	33	33	103	83	83	153	140	140
4	(4)	25	54	34	34	104	(37)	180	154	141	141
5	(5)	29	55	35	35	105	85	85	155	142	142
6	(6)	37	56	36	36	106	(38)	190	156	143	143
7	(7)	42	57	(26)	134	107	87	87	157	144	144
8	(8)	49	58	38	38	108	(39)	194	158	145	145
9	(9)	52	59	39	39	109	89	89	159	148	148
10	(10)	58	60	40	40	110	90	90	160	149	149
11	(11)	59	61	41	41	111	91	91	161	150	150
12	(12)	60	62	(27)	138	112	92	92	162	151	151
13	(13)	61	63	43	43	113	93	93	163	152	152
14	(14)	67	64	44	44	114	(40)	198	164	154	154
15	(15)	71	65	45	45	115	95	95	165	155	155
16	(16)	75	66	46	46	116	96	96	166	156	156
17	(17)	84	67	47	47	117	97	97	167	157	157
18	(18)	86	68	48	48	118	98	96	168	159	159
19	(19)	88	69	(28)	146	119	99	99	169	160	160
20	(20)	94	70	50	50	120	100	100	170	161	161
21	1	1	71	51	51	121	102	102	171	163	163
22	2	2	72	(29)	147	122	103	103	172	164	164
23	3	3	73	53	53	123	104	104	173	165	165
24	(21)	101	74	54	54	124	105	105	174	166	166
25	5	5	75	55	55	125	106	106	175	168	166
26	6	6	76	56	56	126	107	107	176	169	169
27	7	7	77	57	57	127	108	108	177	170	170
28	8	8	78	(30)	153	128	109	109	178	171	171
29	9	9	79	(31)	158	129	110	110	179	173	173
30	10	10	80	(32)	162	130	111	111	180	174	174
31	(22)	112	81	(33)	167	131	113	113	181	176	176
32	12	12	82	62	62	132	114	114	182	177	177
33	13	13	83	63	63	133	115	115	183	179	179
34	14	14	84	64	64	134	116	116	184	181	181
35	(23)	117	85	65	65	135	118	118	185	182	182
36	16	16	86	66	66	136	119	119	186	183	183
37	17	17	87	(34)	172	137	120	120	187	184	184
38	18	18	86	68	68	138	121	121	188	185	185
39	19	19	89	69	69	139	122	122	189	186	186
40	20	20	90	70	70	140	123	123	190	187	187
41	21	21	91	(35)	175	141	125	125	191	188	188
42	22	22	92	72	72	142	126	126	192	189	189
43	23	23	93	73	73	143	127	127	193	191	191
44	24	24	94	74	74	144	128	128	194	192	192
45	(24)	124	95	(36)	178	145	129	129	195	193	193
46	26	26	96	76	76	146	131	131	196	195	195
47	27	27	97	77	77	147	132	132	197	196	196
48	28	28	98	78	78	148	133	133	198	197	197
49	(25)	130	99	79	79	149	135	135	199	199	199
50	30	30	100	80	80	150	136	136	200	200	200

Preferably, the original label file is in demographic address order. In this way, the final output which coincides with the original label file will be in an order which allows for the maximum postal savings as previously explained. The apparatus and method according to the present invention does not assemble the books in demographic order as should be apparent with reference to the running file representatively shown in Table III. Not having to assemble the books in demographic order allows for greater flexibility in the overall system **10**, particularly, the wrapping assembly **26**, in order to allow for improved results.

As previously noted, a feature of the present invention is to provide a wrapping process which improves the overall operation of the wrapper **30**. As a result, when the manufacturing process begins (Box 52), a predetermined number of products are sent to the pre-wrapper accumulating conveyor **28**. In this example, the pre-wrapper accumulating conveyor **28** is adapted to hold twenty products, ten on the top tier **88** and ten on the bottom tier **90**. It should be noted that the pre-wrapper accumulating conveyor **28** can be adapted to hold more or less than twenty products depending on the circumstances in each case.

With reference to Table II, there are forty magazines out of the list of 200 magazines that are to be wrapped in this set of products. With reference to Table III, the first twenty running file magazines correspond to the first twenty products to be wrapped as identified in Table II. Thus, the first ten magazines of the running file are sent to the top tier **88** of the pre-wrapper accumulating conveyor **28** (Boxes **96** and **98**). Once tier **88** is full, the next ten magazines are directed into tier **90** (Box **100**). As tier **90** is filling up, tier **88** is emptying by sending the first ten products on to the wrapper **30** (Box **104**). The ten magazines from tier **88** are fed one right after the other through the wrapper **30** and delivered to tier **132** of the post-wrapper accumulating conveyor **32** where the products are collected until such time as they are to be delivered to the mail table **38** (Box **128**). Once tier **88** is emptied and the speed control command changed as described above, tier **88** is again ready to receive additional products after tier **90** is full. Preferably, tiers **132** and **134** are designed to accumulate the same number of products as tiers **88** and **90**.

With reference to Table III, as the first twenty magazines are making their way towards the wrapper **30**, the twenty-first running file magazine is next in line. As shown in the running file list, the twenty-first running file magazine corresponds to the first original label file magazine and, therefore, the first output file magazine. As the twenty-first running file product makes its way through the system **10**, since it is not to be wrapped, it is picked up by the wrapper bypassing conveyor **36**. The twenty-second and twenty-third running file magazines correspond to the second and third output file magazines, respectively, neither of which is intended to be wrapped. As a result, the twenty-second and twenty-third magazines are also picked up by the wrapper bypassing conveyor **36**. The twenty-fourth running file magazine has been designated for wrapping. Thus, it will enter previously emptied tier **88**. The twenty-fifth through the thirtieth running file magazines will enter the wrapper bypassing line **108**. The thirty-first running file magazine, having been designated for wrapping, will enter the next position in tier **88**. The thirty-second running file magazine through the thirty-fourth running file magazines will enter the wrapper bypassing line **108**, and so on.

When the twenty-fourth and the thirty-first running file magazines are removed from the stream of products on the conveying line **22**, a gap will be created in the stream of products traveling along the wrapper bypassing line **108**. As the twenty-first through twenty-third running file magazines are deposited on the mail table (the first, second and third output magazines), the fourth output magazine corresponds to a wrapped magazine as shown in Table I. With reference to Table III, the fourth output file magazine corresponds to the first running file magazine now cued up in the top tier **132** of the post-wrapper accumulating conveyor **32**. After the third output magazine (i.e., the twenty-third running file magazine) is deposited on the mail table **38** from the wrapper bypassing conveyor **36**, the post-accumulating conveyor **32** delivers the fourth output magazine (i.e., the first running file magazine) to the mail table **38** which falls in line with the previously deposited output products. The first running file magazine will be deposited in the gap created between the twenty-third and twenty-fifth running file magazines in the stream of products that traveled along the wrapper bypassing line **108**. As a new gap reaches the mail table **38**, the appropriately destined product in the post-wrapper accumulating conveyor **32** will be delivered to the mail table **38** to fill the gap.

As should now be understood, the twenty-fourth running file magazine will travel through the wrapper assembly **26** and be deposited on the mail table **38** when output magazine one hundred one is scheduled to be deposited. This magazine will fill a gap created between running file magazines one hundred twenty and one hundred twenty one. As noted, the tier **88** accepts the twenty-fourth running file magazine and the next nine magazines to be wrapped (RFS#'s **31**, **35**, **45**, **49**, **57**, **62**, **69**, **72** and **78**) before delivering these products to the wrapper **30**. As these RFS#'s are being delivered to the wrapper **30**, tier **90** is ready to accept the next ten products to be wrapped (RFS#'s **79**, **80**, **81**, **87**, **91**, **95**, **104**, **106**, **108** and **114**). The process continues until the last magazine is deposited on the mail table **38**.

It should be recognized that the present invention greatly enhances the flexibility of customizing signatures in a binding and wrapping system and allows magazines having various types of customization to be produced for subscribers in a given postal zone. For example, it may be desirable to send to one subscriber an unwrapped magazine with personalized messages and send his neighbor, a new subscriber, a wrapped magazine including a coupon for free/discounted merchandise, a welcome greeting and a sample of a flat packaged new product such as a compact disk, a shampoo packet, or the like. Unlike prior art systems which wrap each customized publication apart from those publications bound in a binding system, the present invention provides improved selectivity by combining a binding line with a wrapping line, which saves money and time by wrapping only preselected products from a single stream of products, yet offers further customization and optimal sortation.

The foregoing description of the present invention has been presented for purposes of illustration and description. Furthermore, the description is not intended to limit the invention in the form disclosed herein. Consequently, variations and modifications commensurate with the above teachings in skill or knowledge of the relevant art, are within the scope of the present invention. The embodiments described herein are further intended to explain the best modes known for practicing the invention and to enable others skilled in the art to utilize the invention as such, or other embodiments and with various modifications required by the particular applications or uses of the present invention. It is intended that the appended claims are to be construed to include alternative embodiments to the extent permitted by the prior art.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. An apparatus for wrapping selected products from a plurality of products, said apparatus comprising:

an in-feed conveyor for continuously moving a stream of a plurality of products along an in-feed path;

a wrapper bypassing conveyor positioned along said in-feed path adapted to deliver certain selected products from said in-feed path to a further processing destination;

a wrapper for individually wrapping selected products within the stream of products;

a pre-wrapper accumulating conveyor including a first portion and a second portion, each of said first and second portions extends from the in-feed conveyor to the wrapper, wherein the first and second portions of the pre-wrapper accumulating conveyor alternatingly operate such that one of said first and second portions operates at the speed of the in-feed conveyor to receive the selected products from the in-feed conveyor and the other of said first and second portions operates at the speed of the wrapper to supply the selected products to the wrapper;

a post-wrapper accumulating conveyor including a first portion and a second portion, each of said first and second portions extends from the wrapper to the wrapper bypassing conveyor, wherein the first and second portions of the post-wrapper accumulating conveyor alternatingly operate such that one of said first and second portions operates at the speed of the wrapper to receive the selected products from the wrapper and the other of said first and second portions operates at the speed of the wrapper bypassing conveyor to supply the selected products to the wrapper bypassing conveyor; and

a control unit for determining in a pre-processing step which products shall be wrapped and therefore travel through said wrapper and which products shall not be wrapped and therefore travel along said wrapper bypassing conveyor.

2. An apparatus according to claim 1, wherein the first portion of the pre-wrapper accumulating conveyor is a first tier and the second portion of the pre-wrapper accumulating conveyor is a second tier.

3. An apparatus according to claim 2, wherein only one of said first and second tiers receives and collects the selected products at any given time.

4. An apparatus according to claim 2, wherein only one of said first and second tiers conveys the selected products to the wrapper at any given time.

5. An apparatus according to claim 2, further comprising:

a diverter device positioned upstream of said pre-wrapper accumulating conveyor for directing products into the appropriate first or second tier.

6. An apparatus according to claim 2, further comprising:

a diverter device positioned downstream of said pre-wrapper accumulating conveyor and upstream of said wrapper for directing products into said wrapper from said appropriate first or second tier.

7. An apparatus according to claim 1, wherein said post-wrapper accumulating conveyor includes a first tier and a second tier.

8. An apparatus according to claim 7, wherein only one of said first and second tiers receives and collects selected wrapped products at any given time.

9. An apparatus according to claim 7, wherein only one of said first and second tiers conveys the wrapped products to the transport conveyor at any given time.

10. An apparatus according to claim 7, further comprising:

a diverter device positioned downstream of the wrapper and upstream of the post-accumulating conveyor for directing products into the appropriate first or second tier.

11. An apparatus according to claim 7, further comprising:

a diverter device positioned downstream of the post-wrapper accumulating conveyor for directing products from the appropriate first or second tier to the transport conveyor.

* * * * *

US006748294B1

(12) **United States Patent**
Overman et al.

(10) **Patent No.: US 6,748,294 B1**
(45) **Date of Patent: Jun. 8, 2004**

(54) **FLATS BUNDLE COLLATOR**

(75) Inventors: **John Overman**, Evanston, IL (US); **George Rubindran**, Davie, FL (US); **Steve Archer**, Des Plaines, IL (US); **Dan Rice**, deceased, late of Buffalo Grove, IL (US), by **Sherrie Rice**, legal representative; **Tom Wells**, Crystal Lake, IL (US); **Ken Guenther**, Antioch, IL (US)

(73) Assignee: **Bowe Bell + Howell Postal Systems Company**, Lincolnwood, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/694,403**

(22) Filed: **Oct. 23, 2000**

(51) **Int. Cl.**[7] **G06F 7/00**

(52) **U.S. Cl.** **700/224**; 700/225; 700/226; 414/796.5; 414/796.7; 414/796.9; 414/797; 270/52.02; 270/52.04

(58) **Field of Search** **700/213**, 225, 700/226, 223, 224; 414/795.4, 796.5, 796.7, 796.9, 797; 270/52.01, 52.02, 52.04; 209/584, 900, 905

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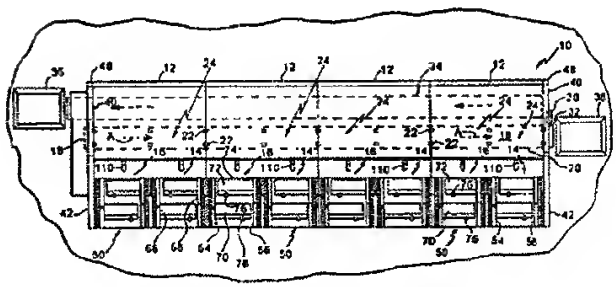
Primary Examiner—Khoi H. Tran
(74) *Attorney, Agent, or Firm*—McDermott, Will & Emery

(57) **ABSTRACT**

The present invention relates to an apparatus for collating a plurality of separate groups or bundles of similar flats mailpieces arranged in a predetermined delivery point sequence, each mailpiece imprinted with a distinct delivery point or address indicia, to produce a single stream of mailpieces in new groups, where each new group comprises a plurality of mailpieces all addressed to a distinct delivery point. The apparatus comprises a plurality of feed units, each unit configured to process a quantity of similar mailpieces, each with a distinct delivery point indicia on the face of the mailpiece, and to deposit each mailpiece in a distinct pocket on a collation conveyor which traverses all of the plurality of feed units. Each pocket will ultimately contain different mail pieces, all addressed to the same delivery point. Multiple new groups of mailpieces are then automatically placed in containers in a sequence corresponding to a predetermined delivery route.

30 Claims, 25 Drawing Sheets



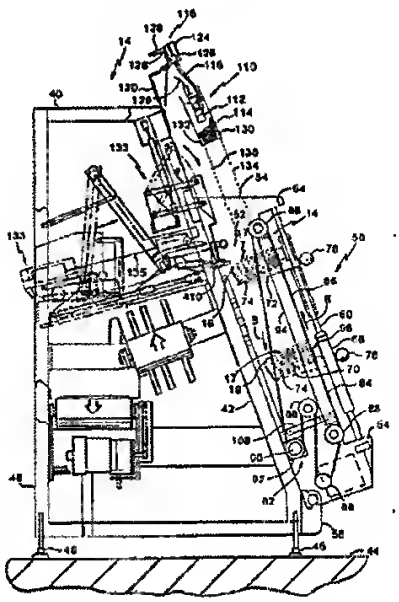


Fig. 1

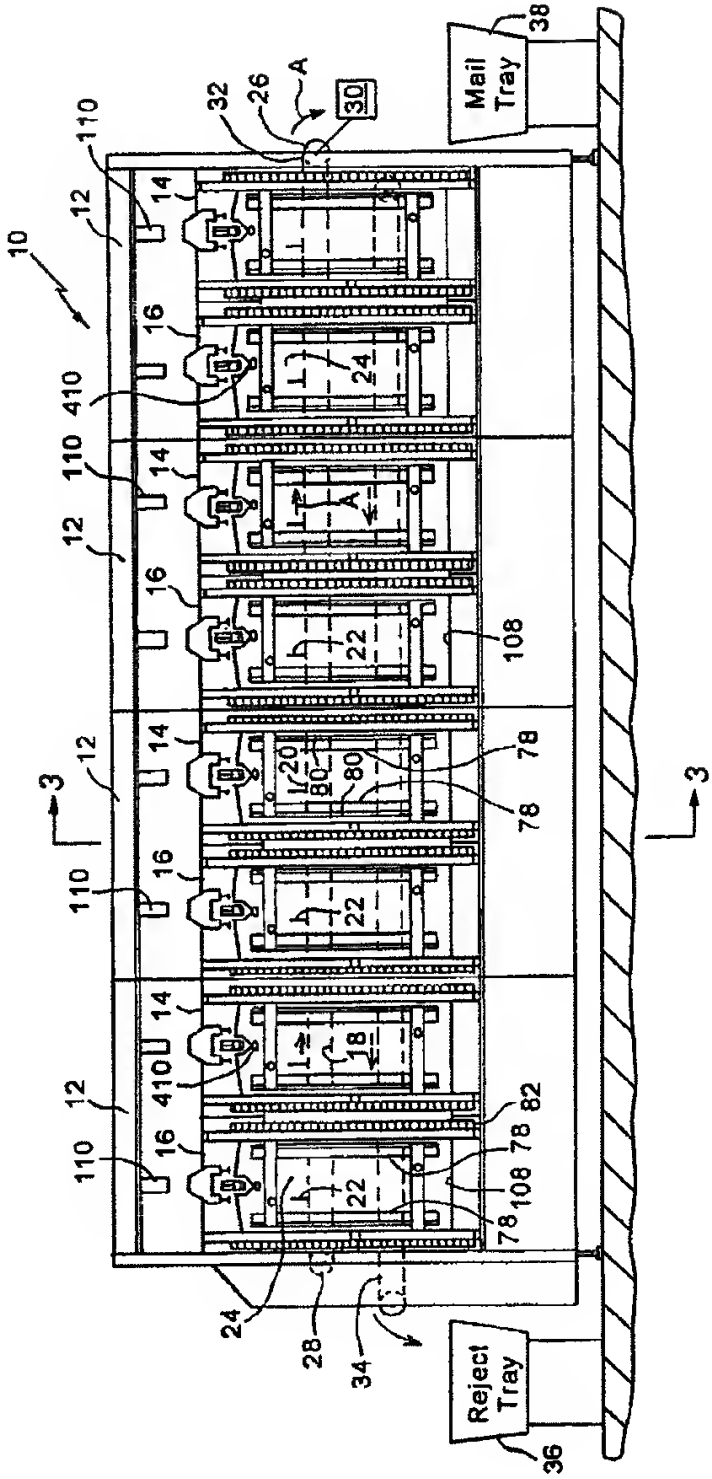

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Fig. 1A

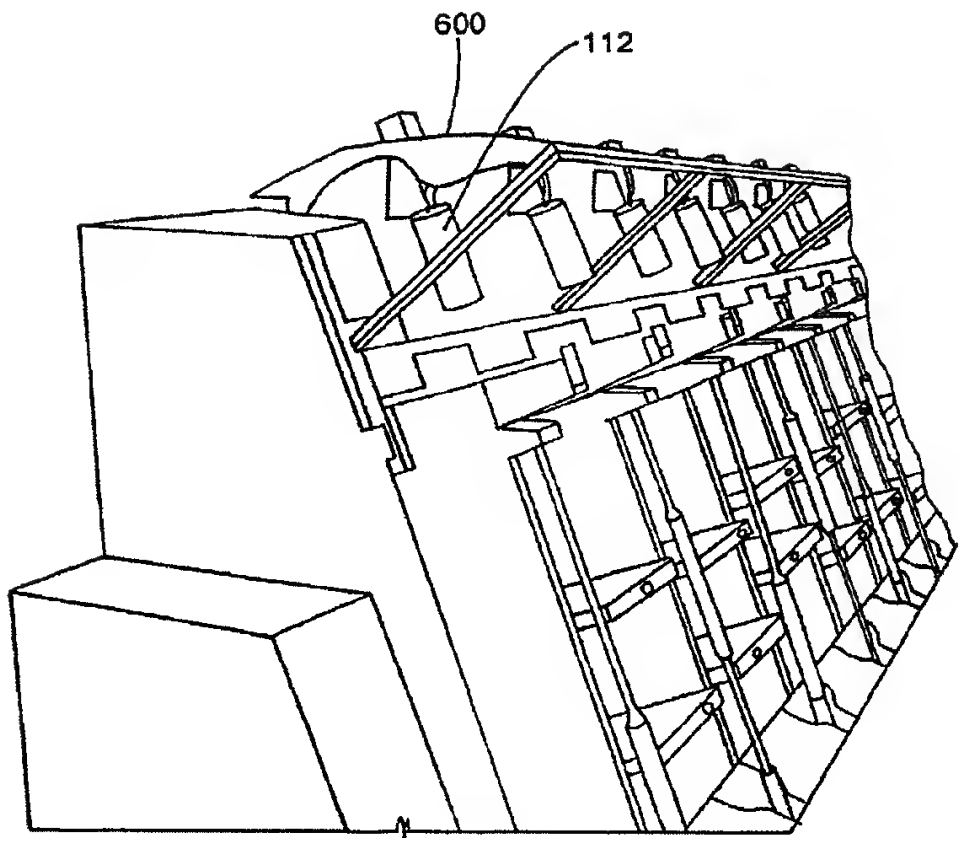

Fig. 2

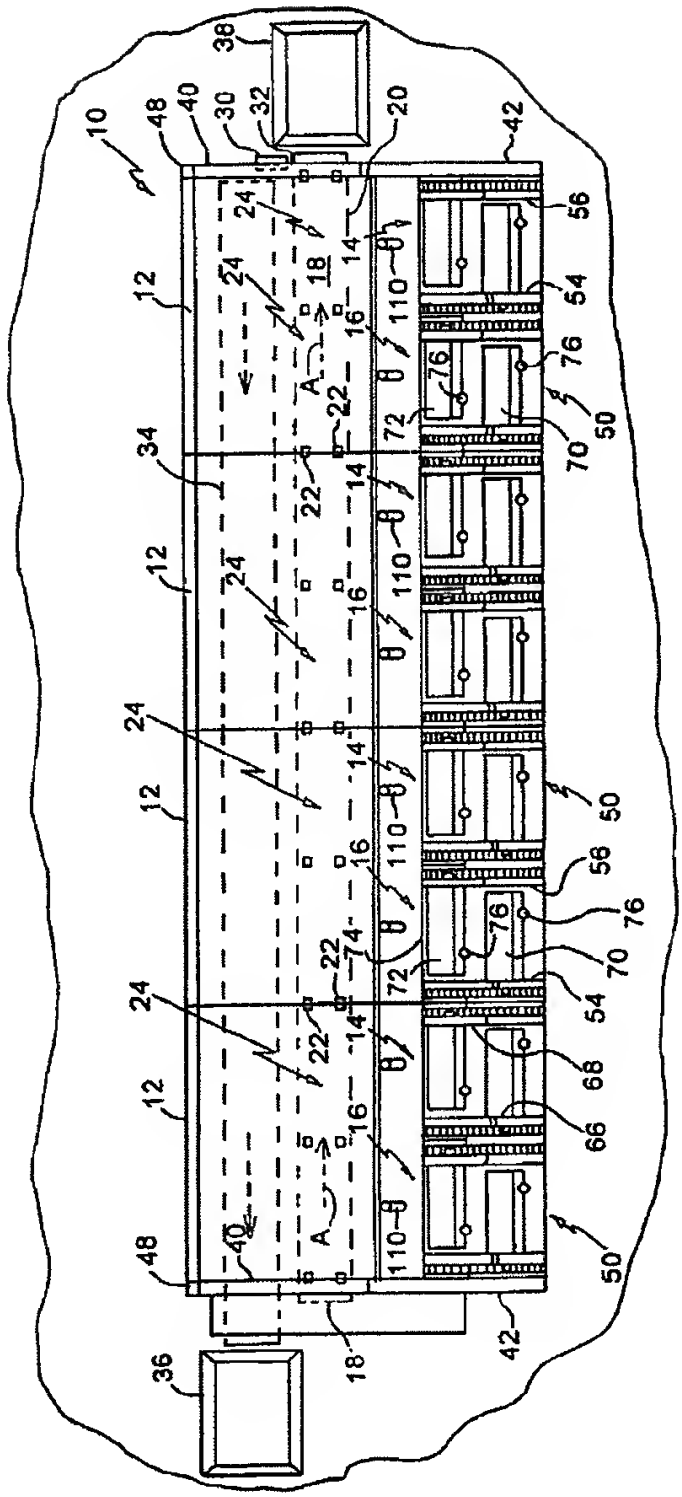
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Fig. 3

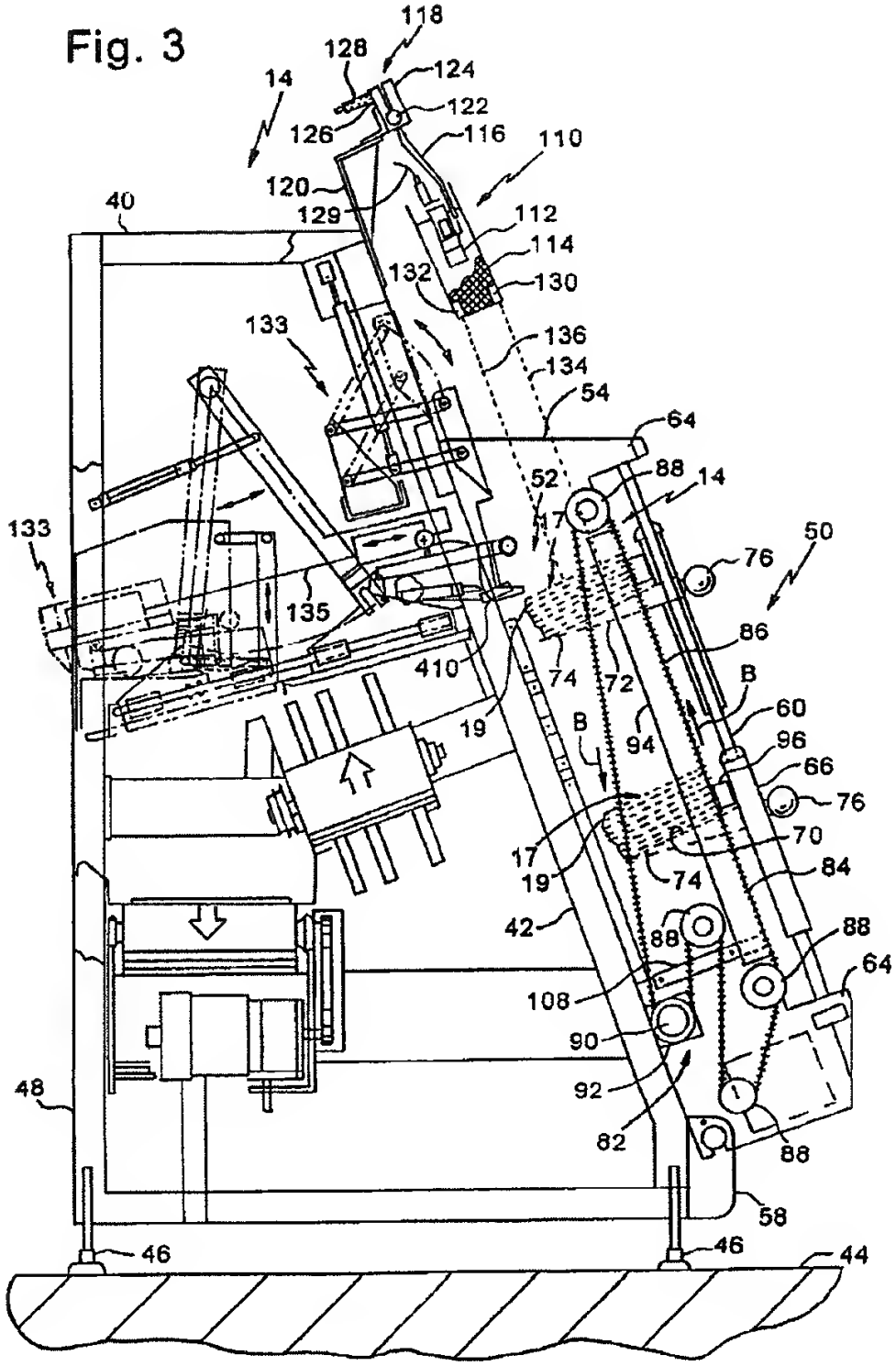
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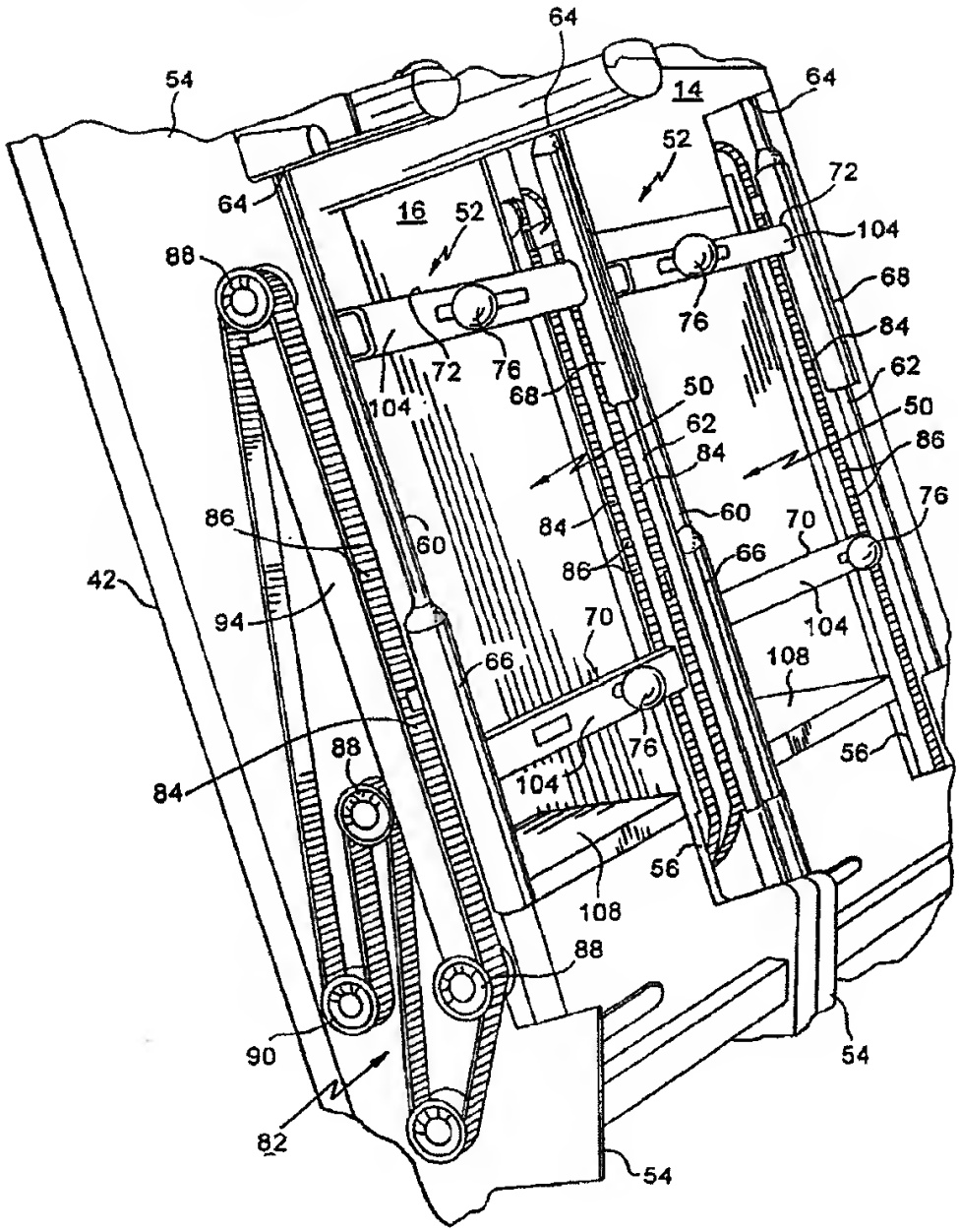
Fig. 4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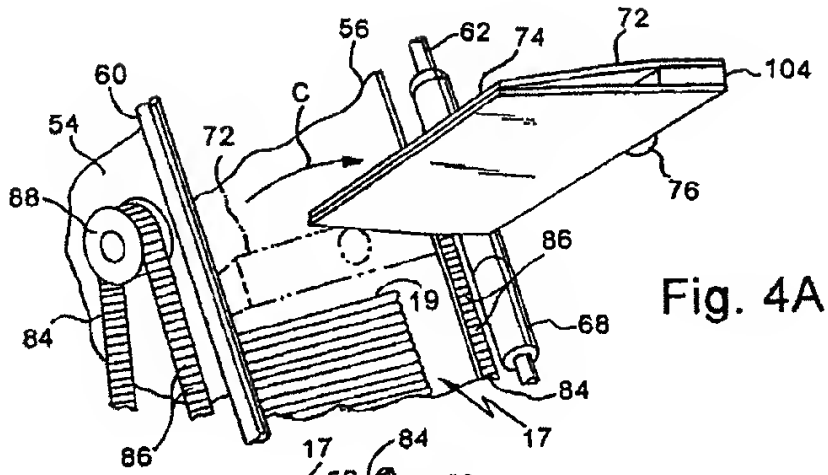


Fig. 4A

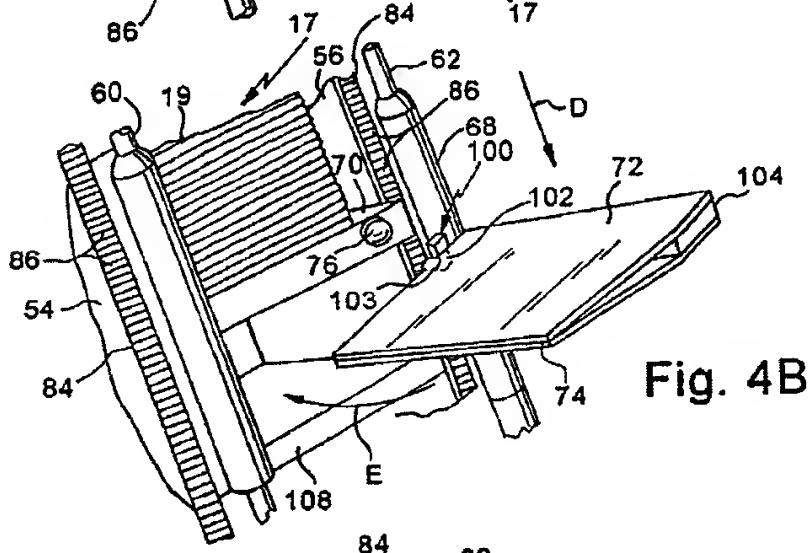


Fig. 4B

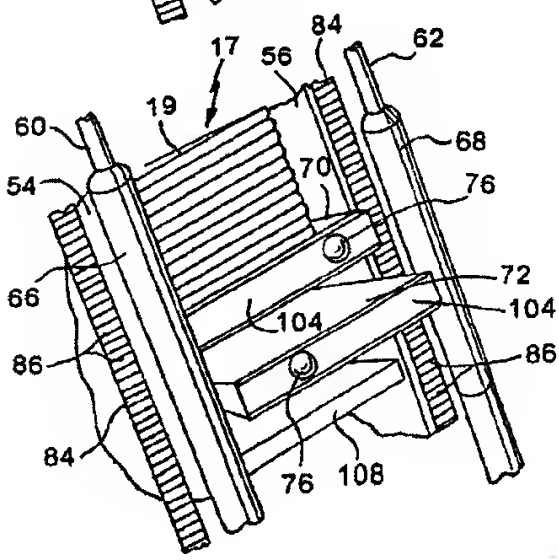


Fig. 4C

Fig. 5

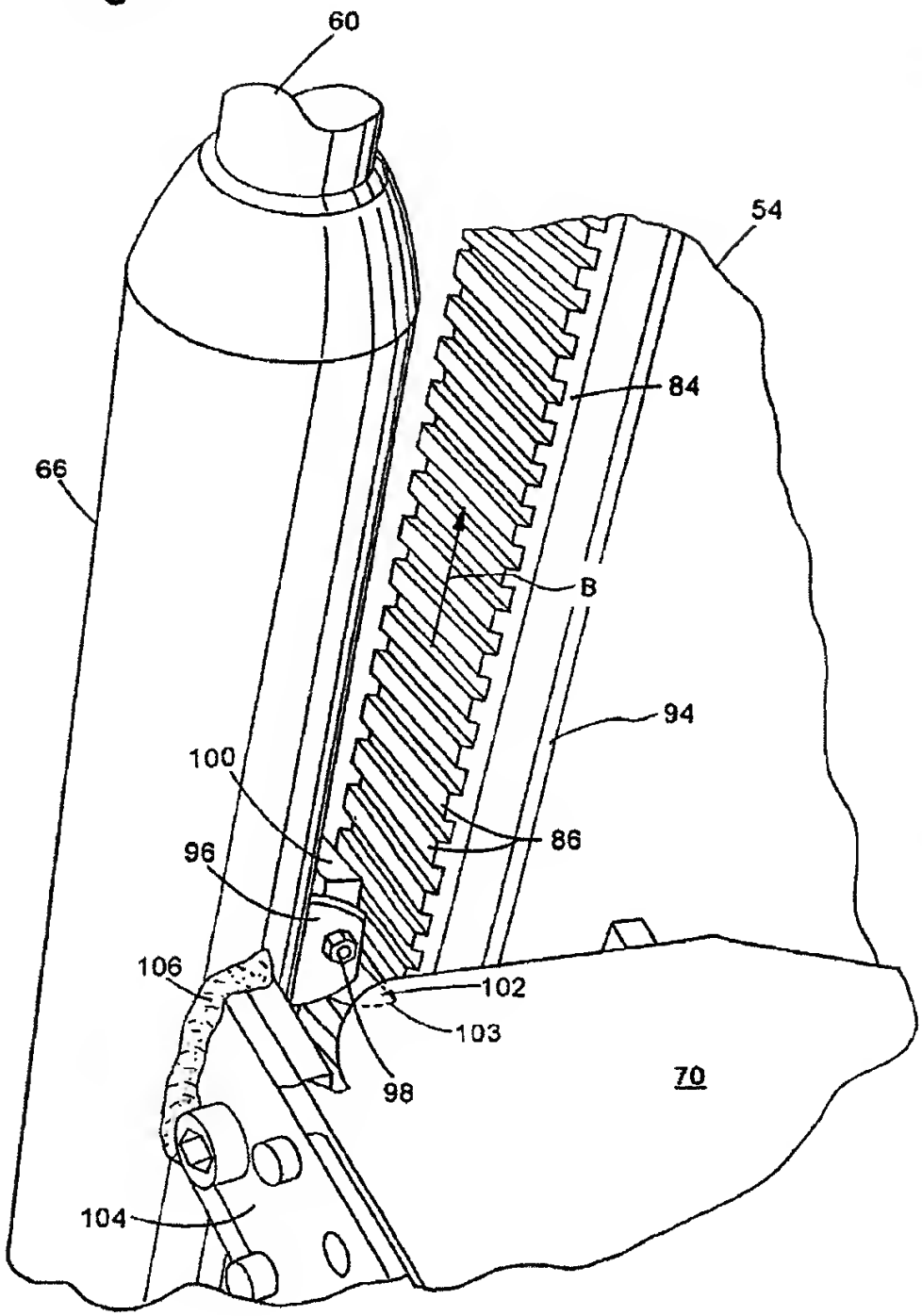
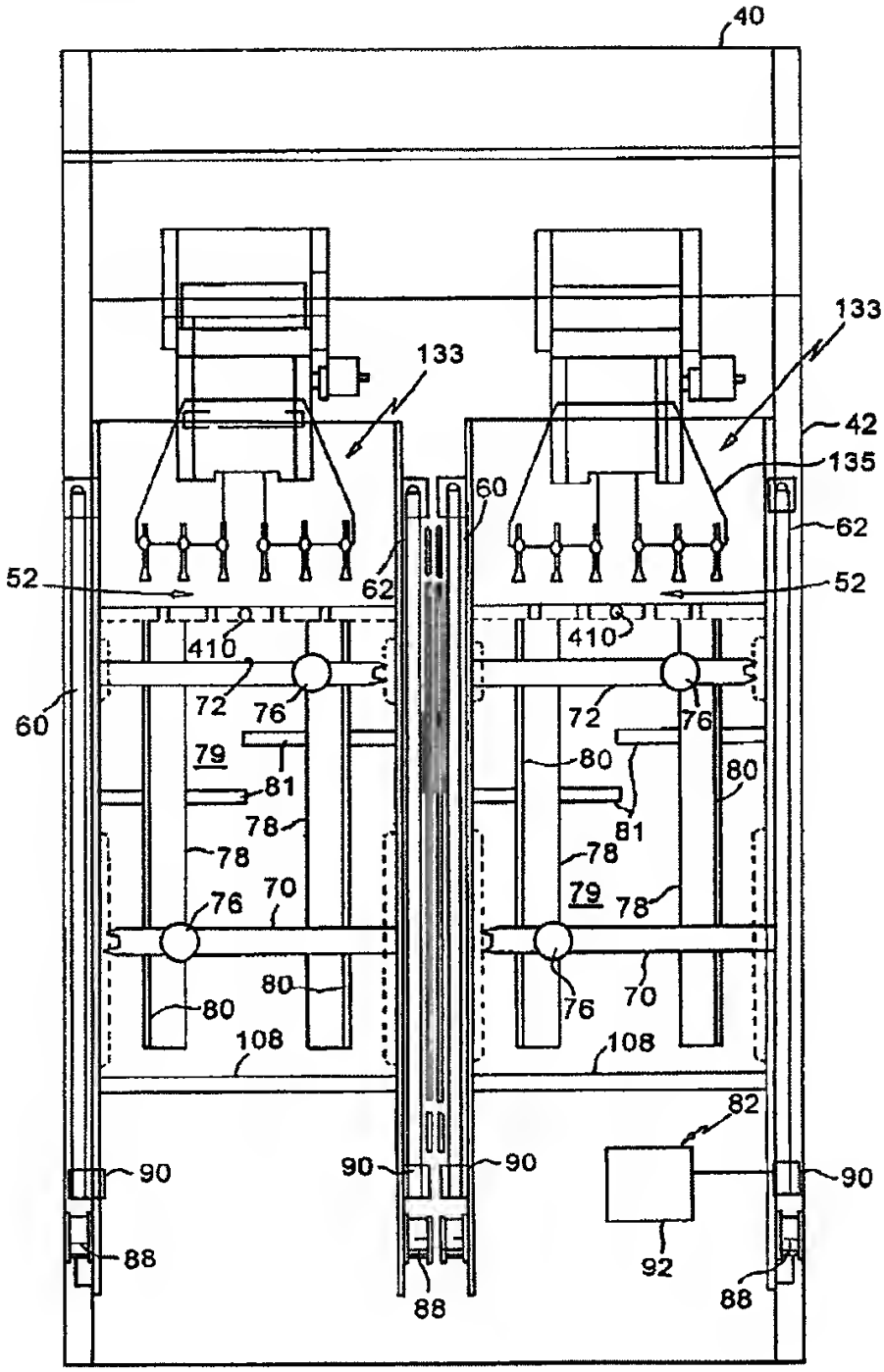


Fig. 6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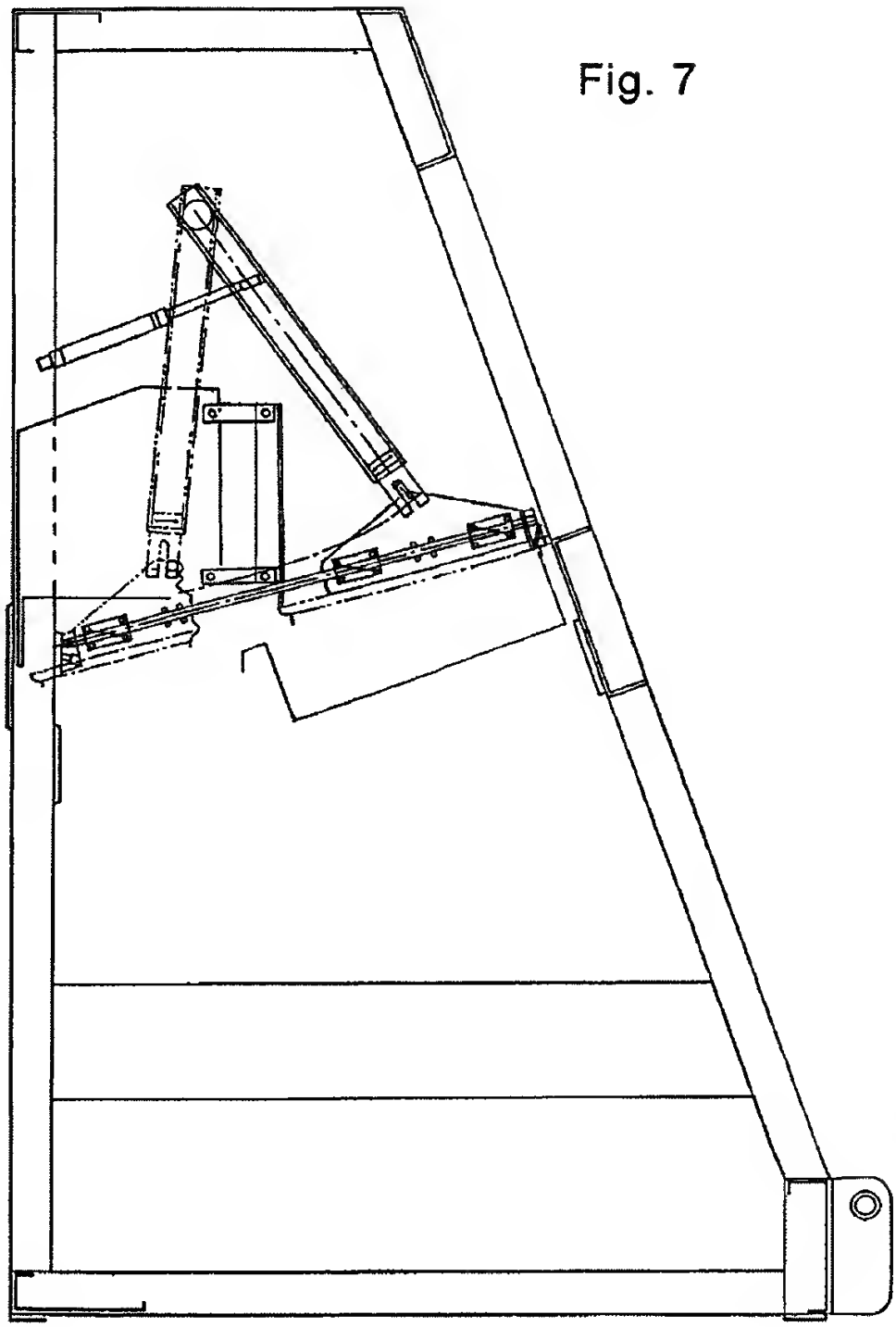


Fig. 7

Fig. 8

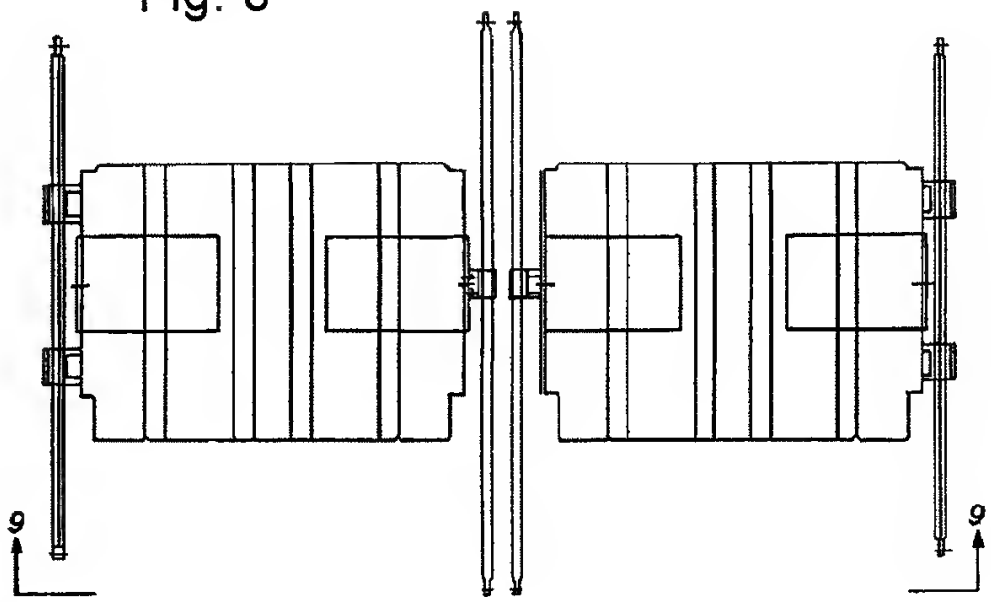


Fig. 9

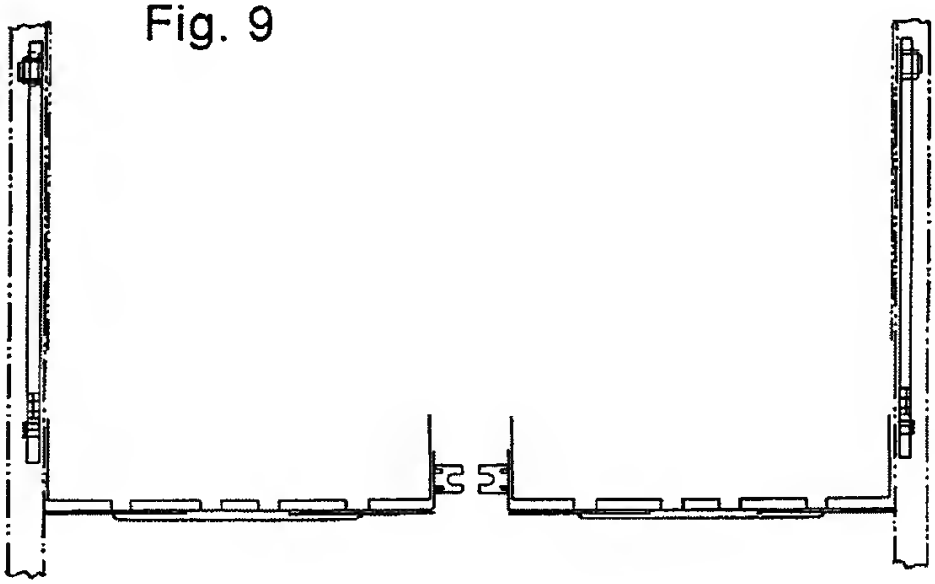


Fig. 9A

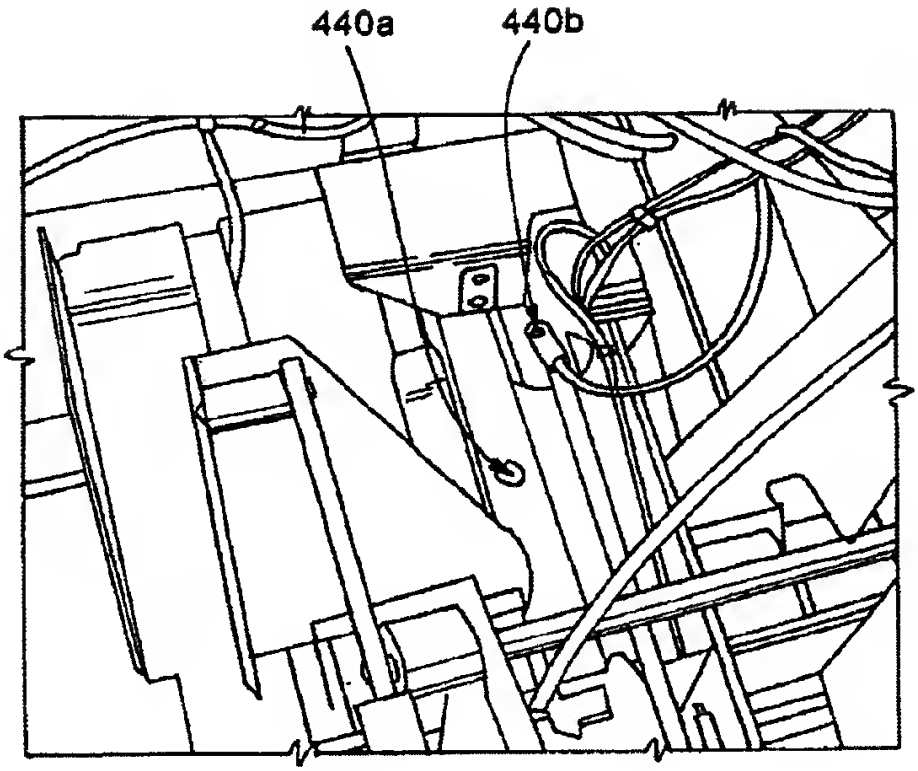


Fig. 10

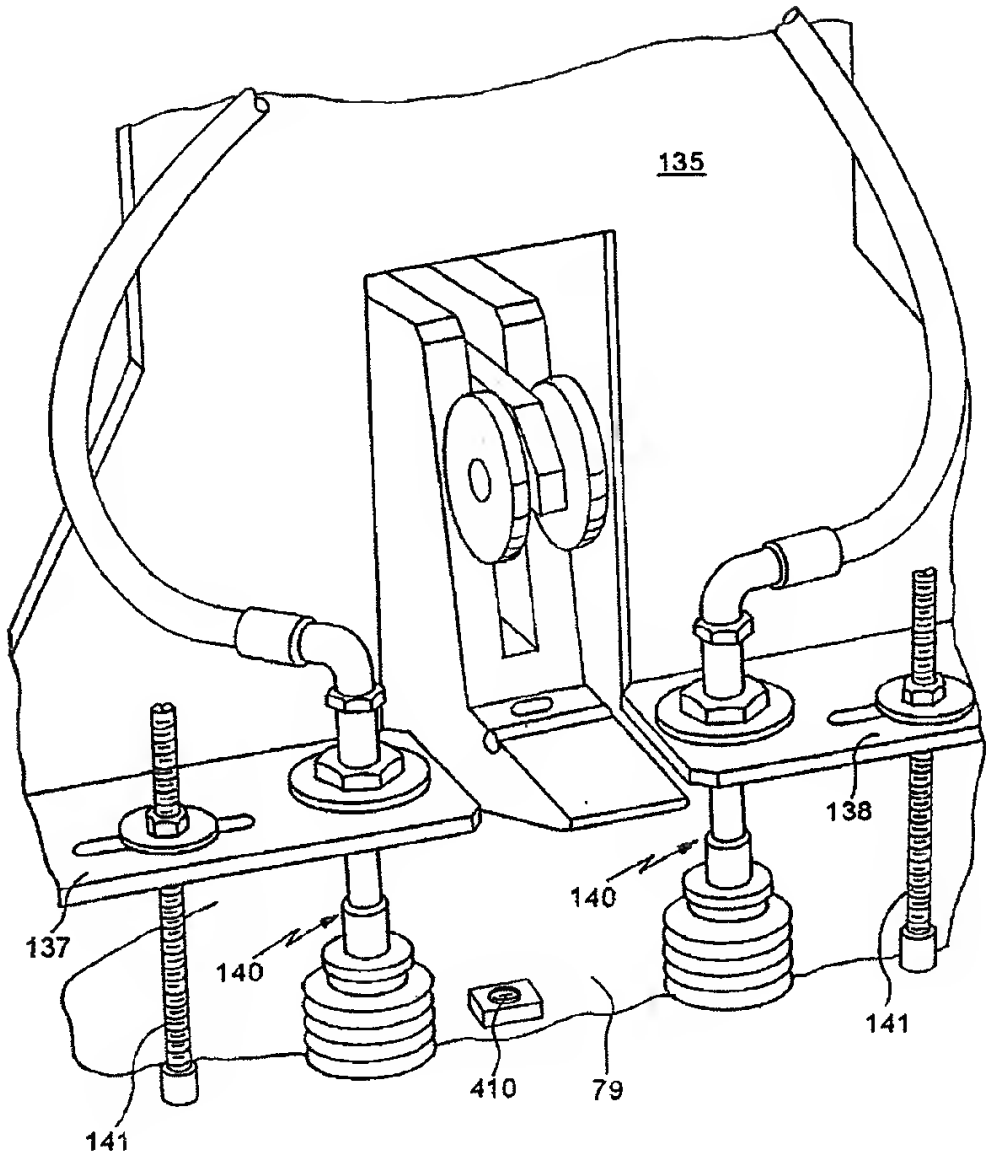


Fig. 10A

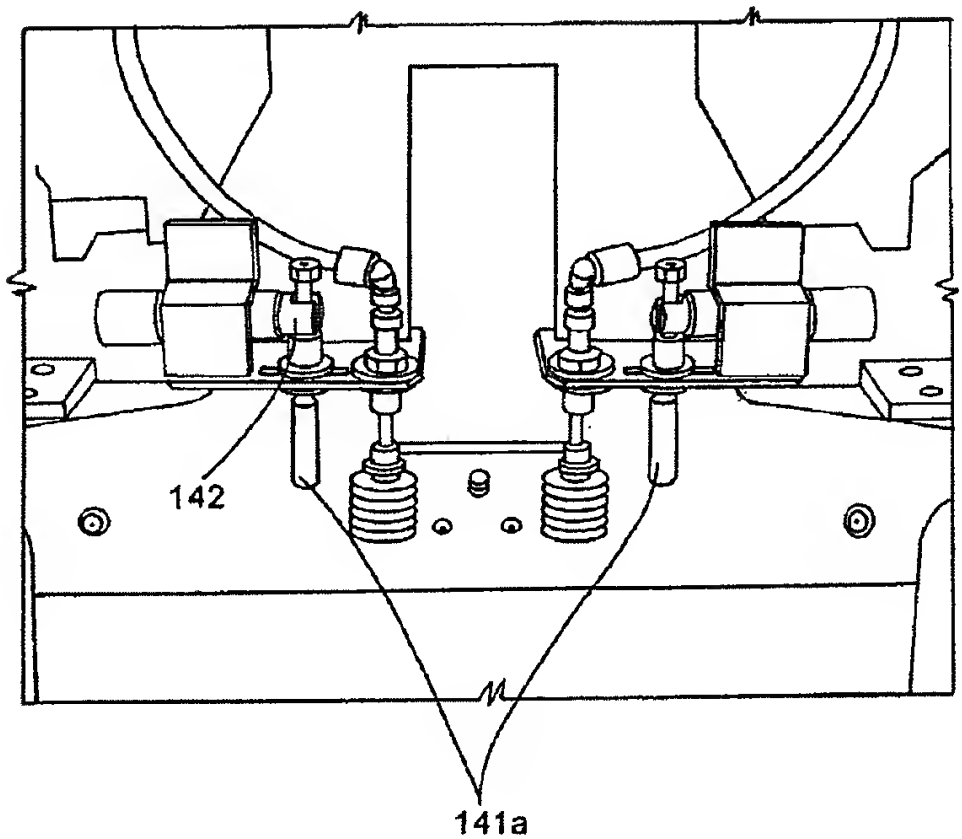
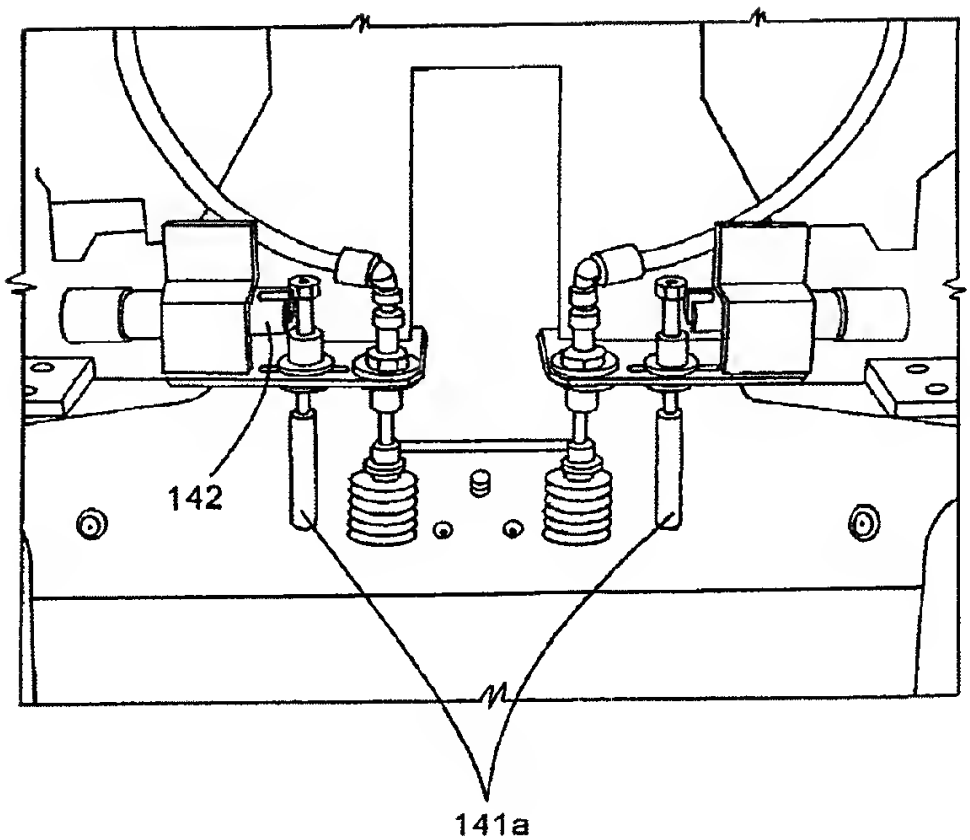


Fig. 10B



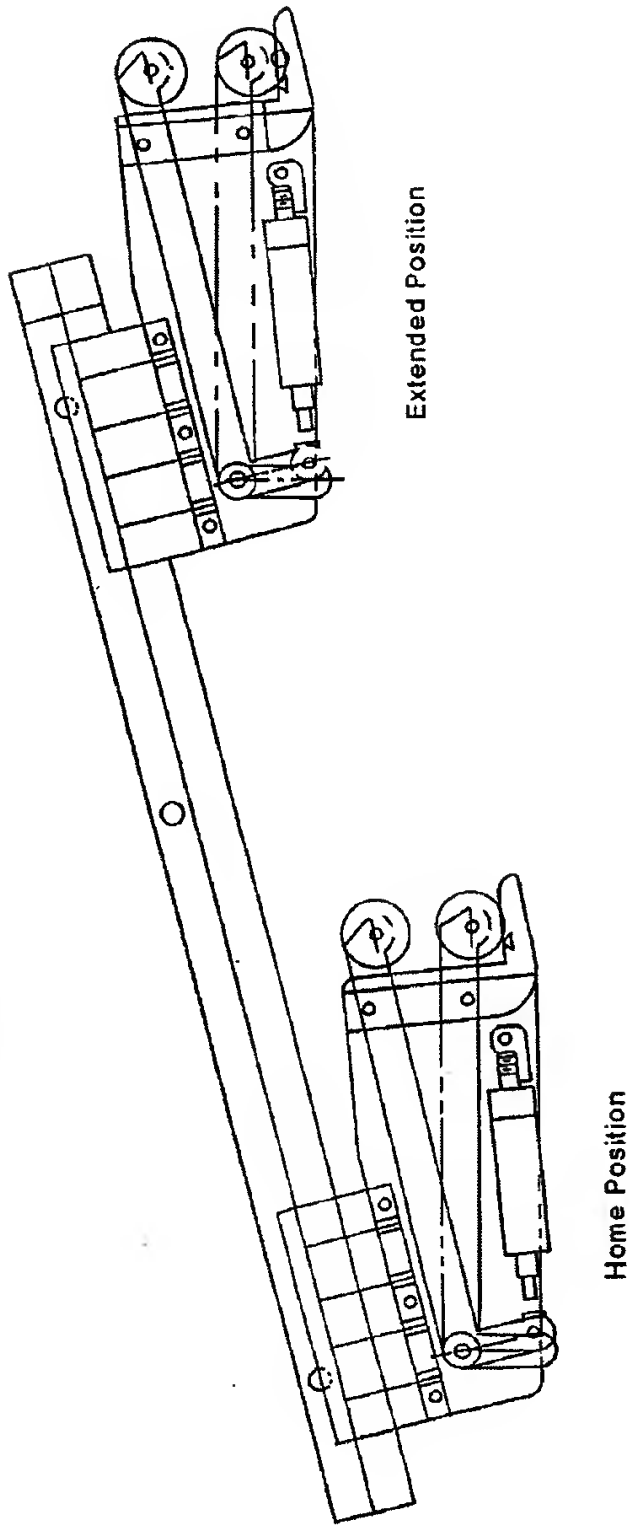


Fig. 11

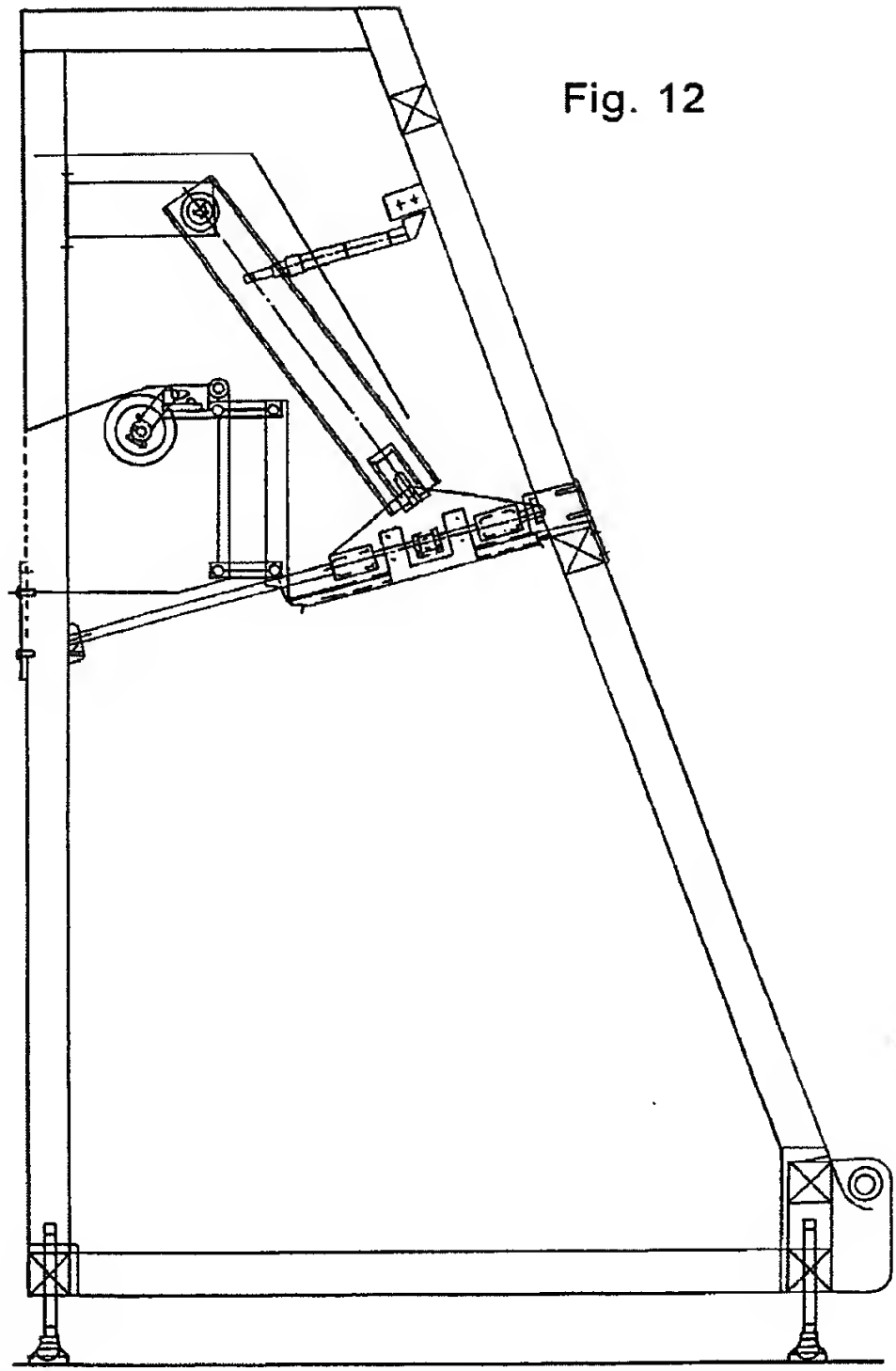


Fig. 12

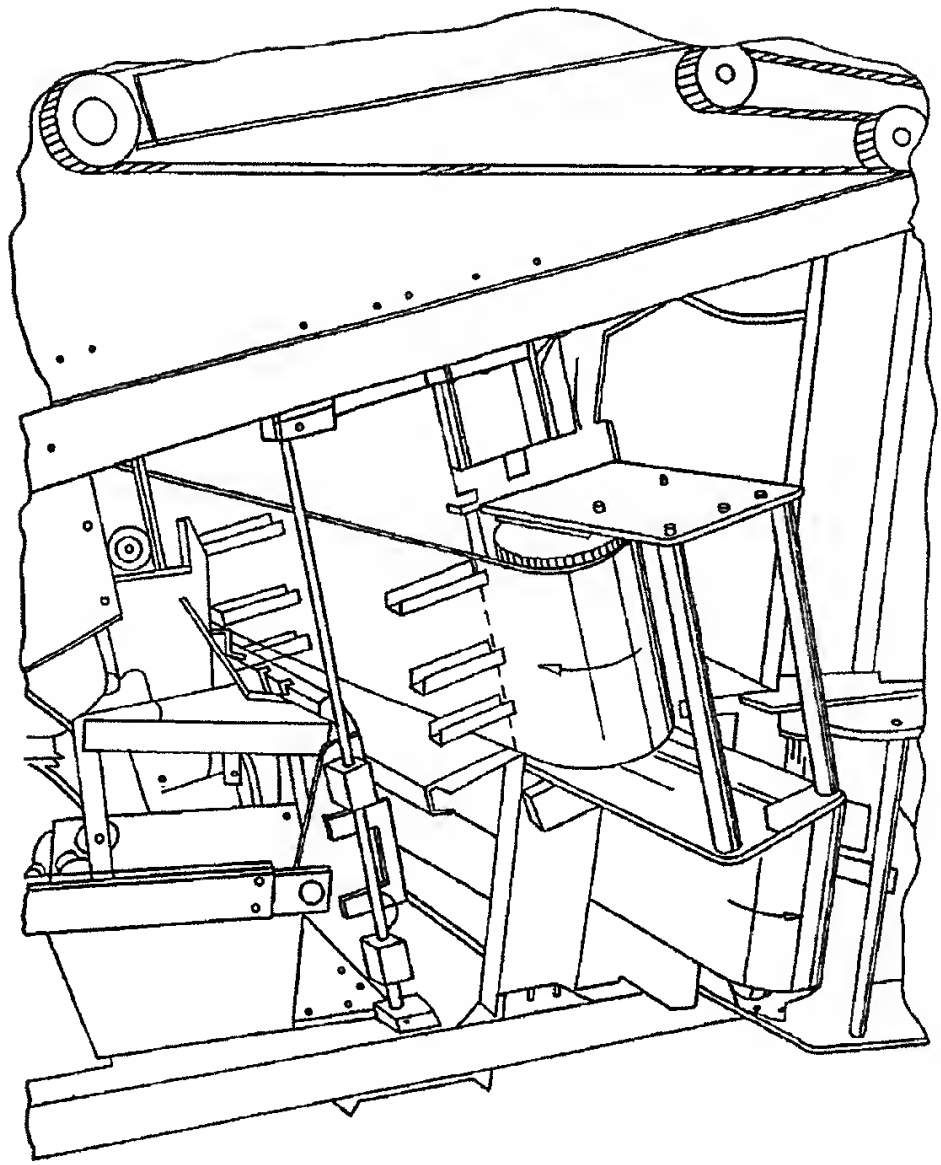


Fig. 13

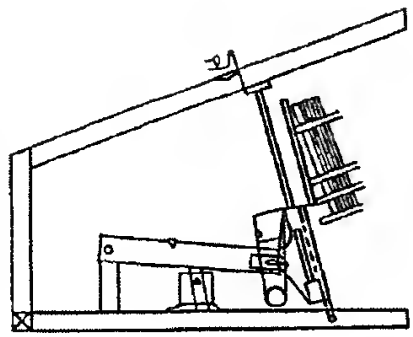


Fig. 14C

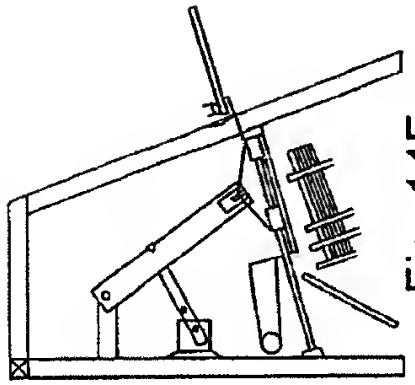


Fig. 14F

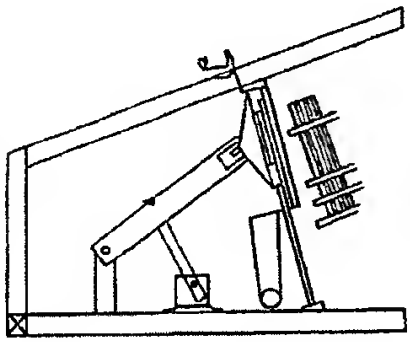


Fig. 14B

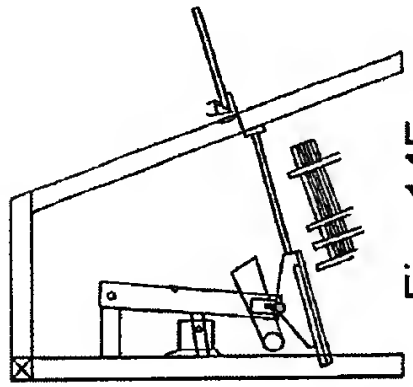


Fig. 14E

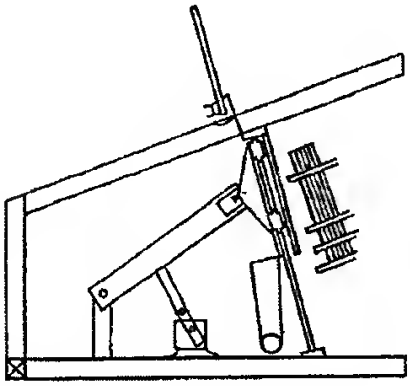


Fig. 14A

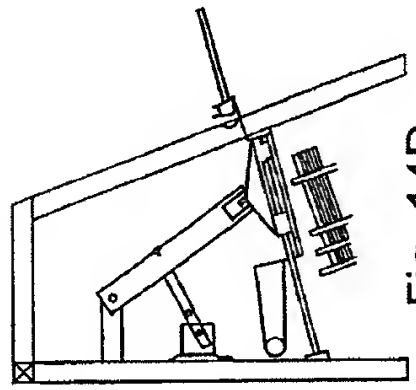
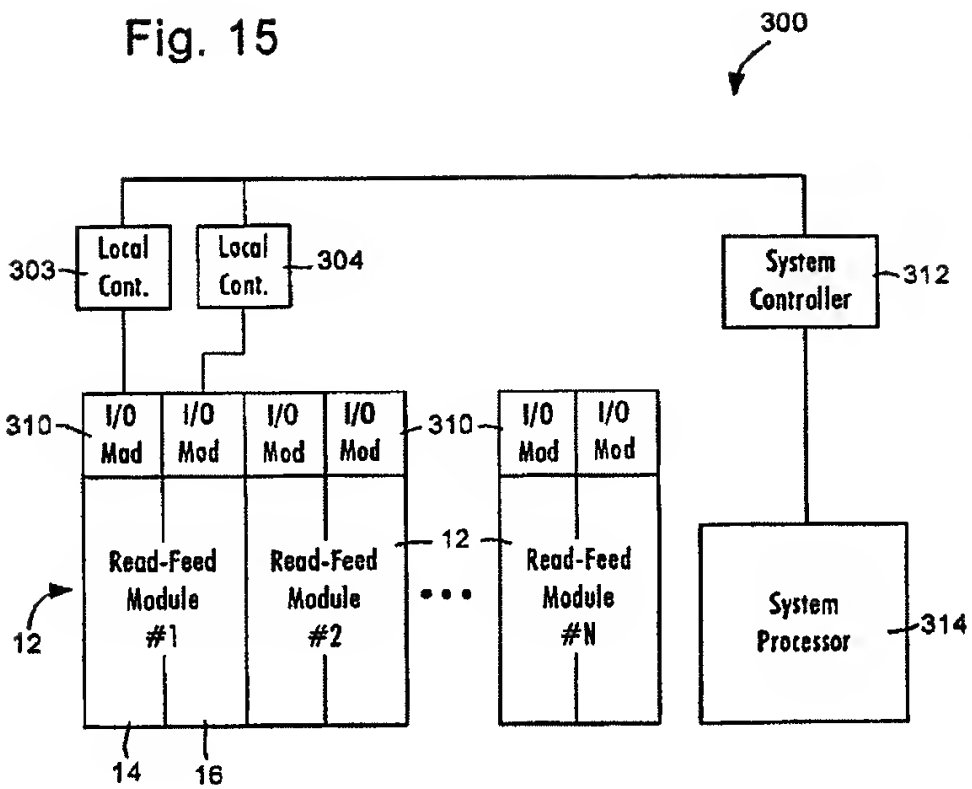


Fig. 14D

Fig. 15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Local Cont.
Local Cont.
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System Controller
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I/O Mod
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Read-Feed Module #1
Read-Feed Module #2
Read-Feed Module #N
System Processor
314
12
14
16

Fig. 16A

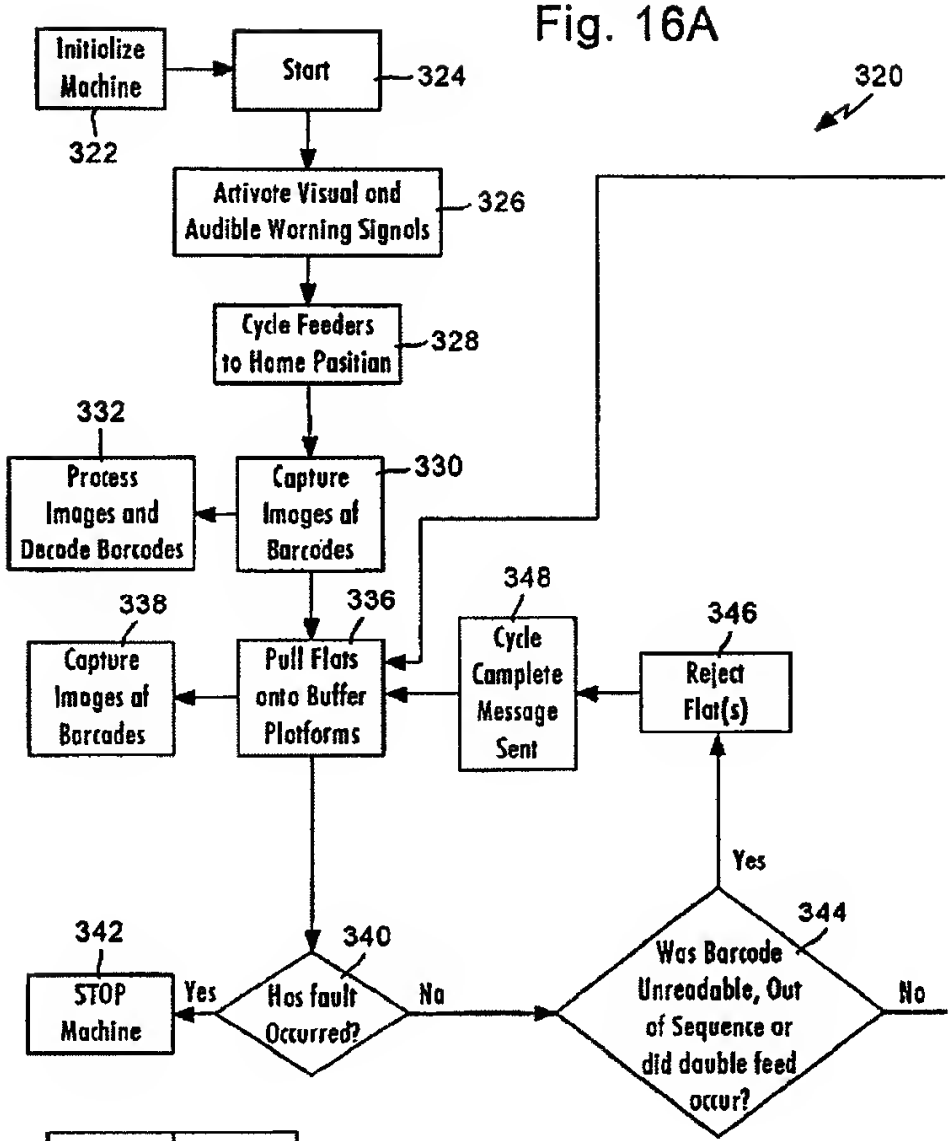
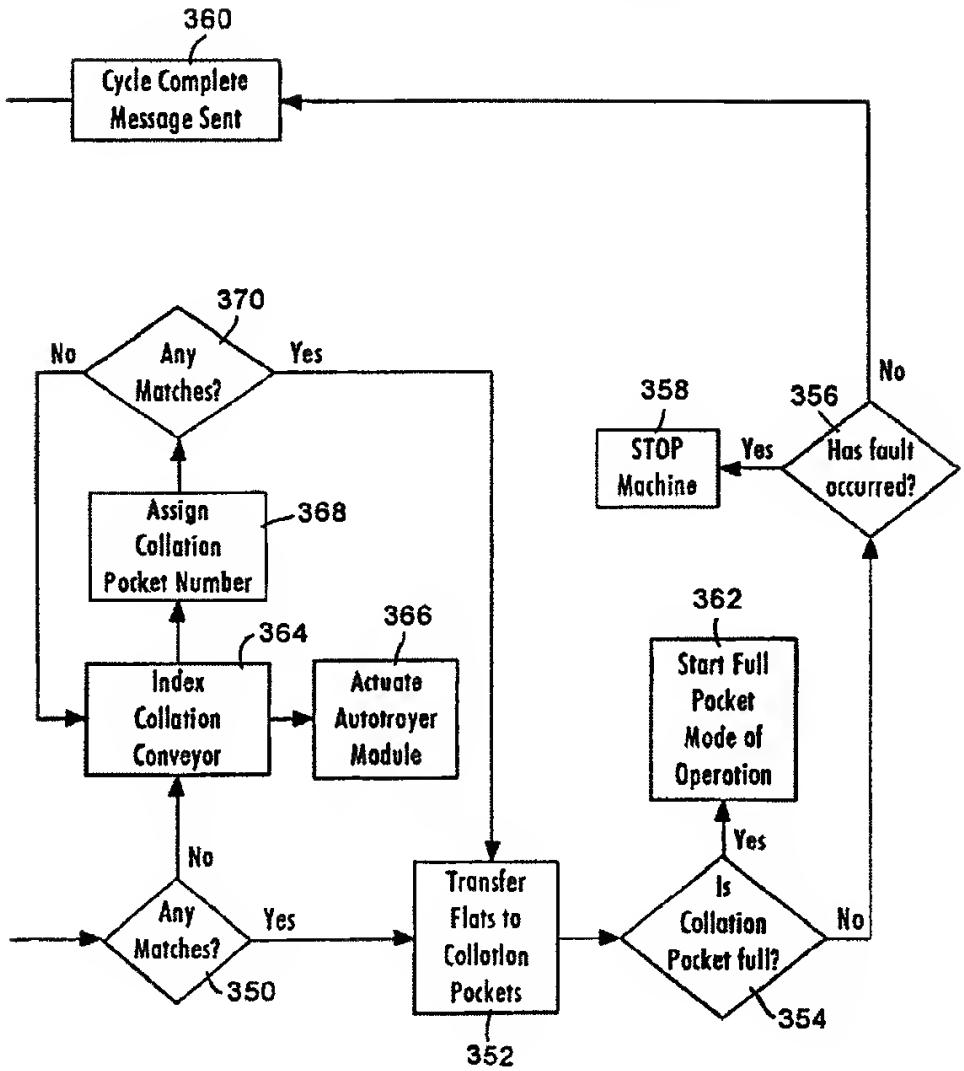


Fig. 16A | Fig. 16B

Fig. 16

Fig. 16B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Index Collation Conveyor
364
Actuate Autotroyer Module
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Any Matches?
No
Yes
350
Transfer Flats to Collation Pockets
352
Is Collation Pocket full?
Yes
No
354
Start Full Pocket Mode of Operation
362
STOP Machine
358
Yes
Has fault occurred?
356
No

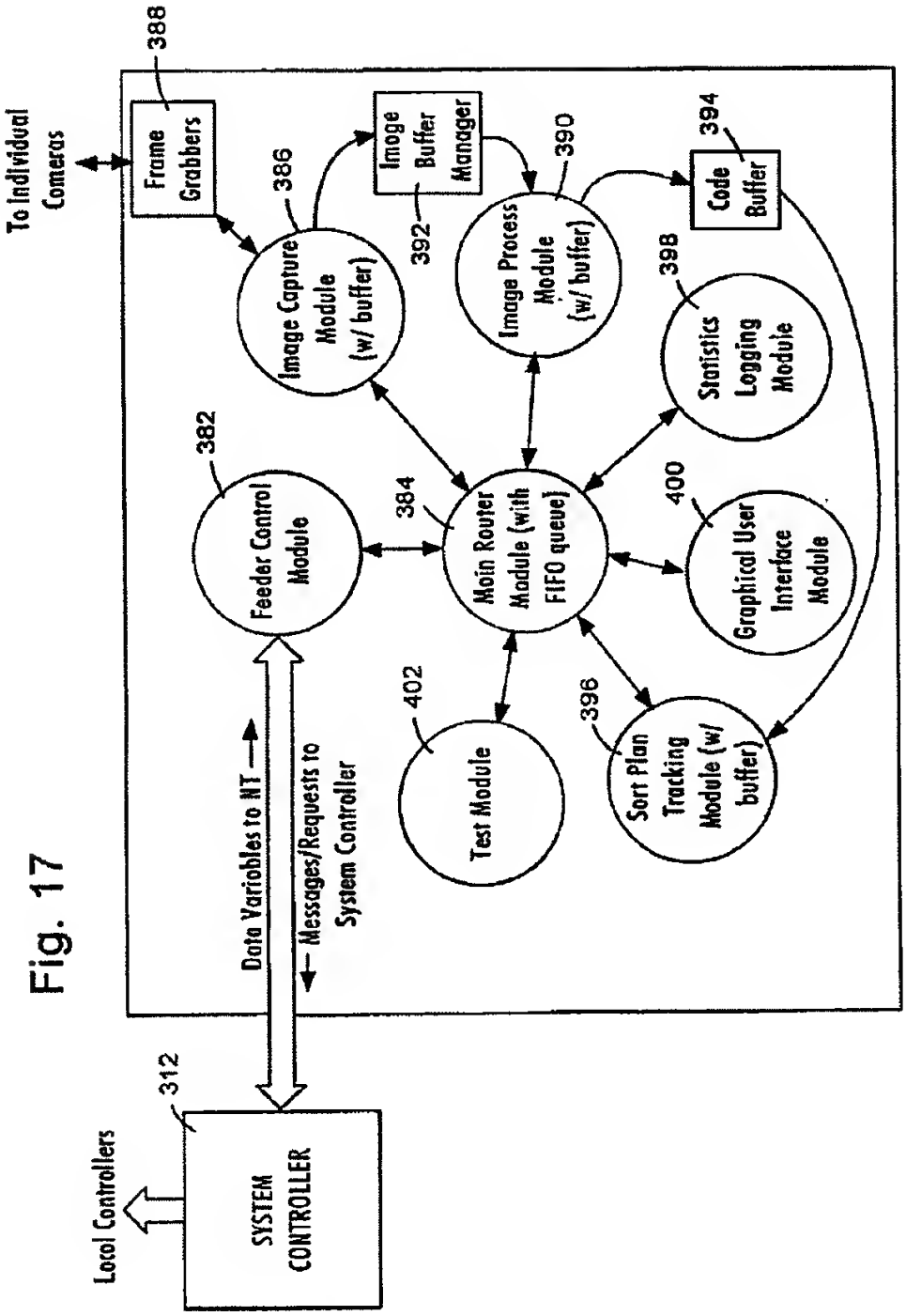

To Individual Cameras
388
Frame Grabbers
386
Image Capture Module (w/ buffer)
Image Buffer Manager
392
390
Image Process Module (w/ buffer)
394
Code Buffer
398
Statistics Logging Module
382
Feeder Control Module
384
Main Router Module (with FIFO queue)
400
Graphical User Interface Module
402
Test Module
396
Sort Plan Tracking Module (w/ buffer)
Data Variables to NT
Messages/Requests to System Controller
312
SYSTEM CONTROLLER
Local Controllers

Fig. 17

Fig. 18

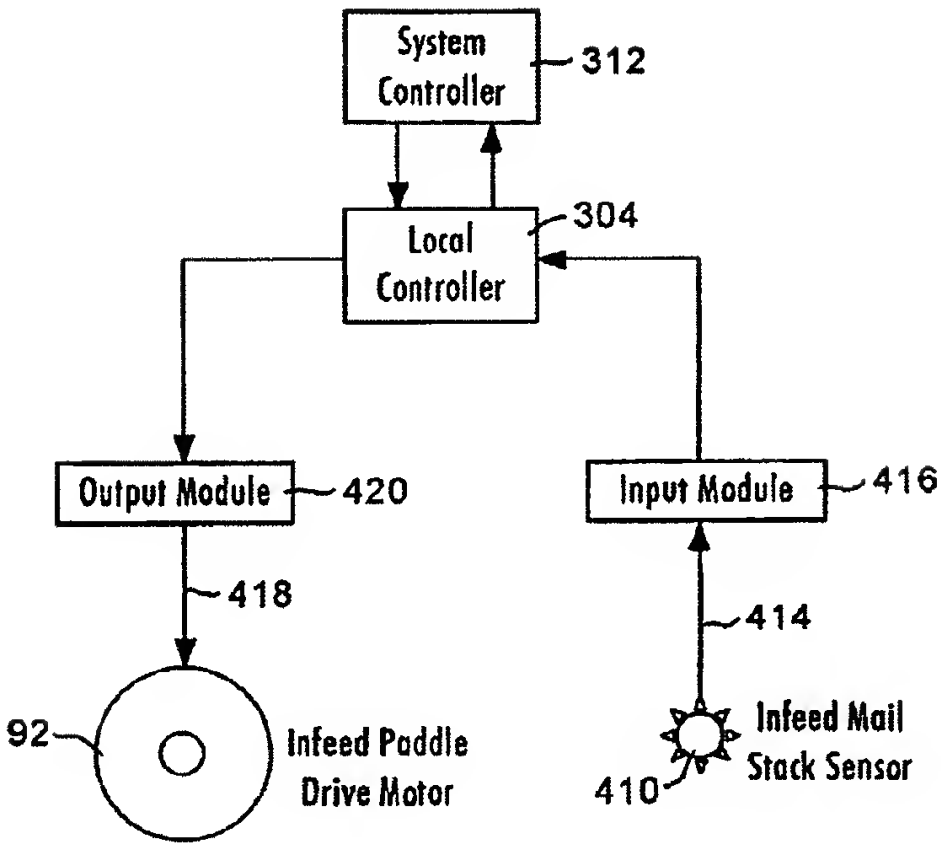

System Controller
312
Local Controller
304
Output Module
420
Input Module
416
418
414
92
Infeed Paddle Drive Motor
Infeed Mail Stack Sensor
410

Fig. 19

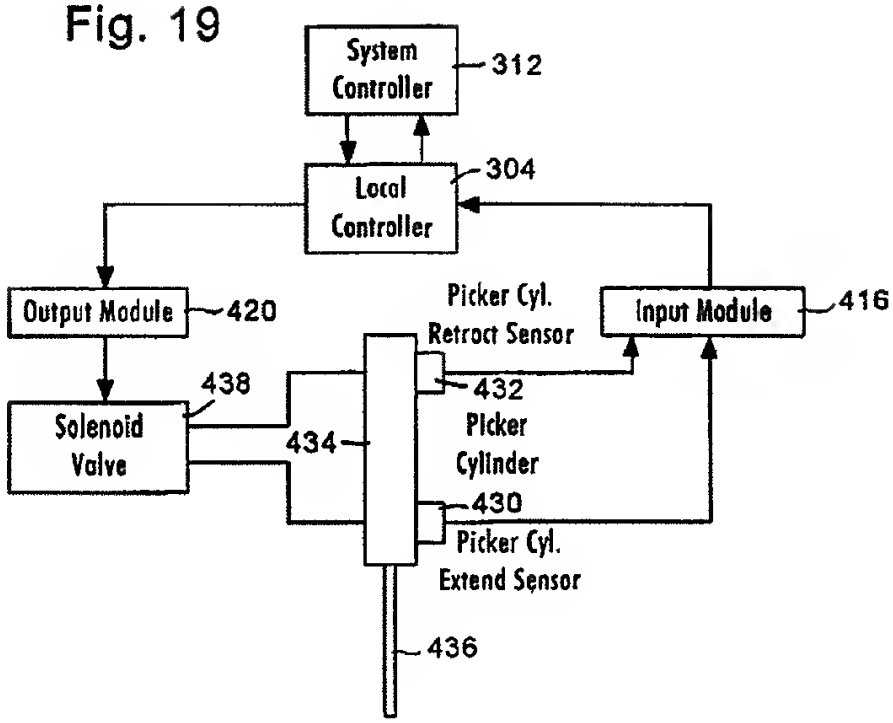

System Controller
312
Local Controller
304
Output Module
420
Picker Cyl. Retract Sensor
Input Module
416
438
Solenoid Valve
434
432
Picker Cylinder
430
Picker Cyl. Extend Sensor
436

Fig. 20

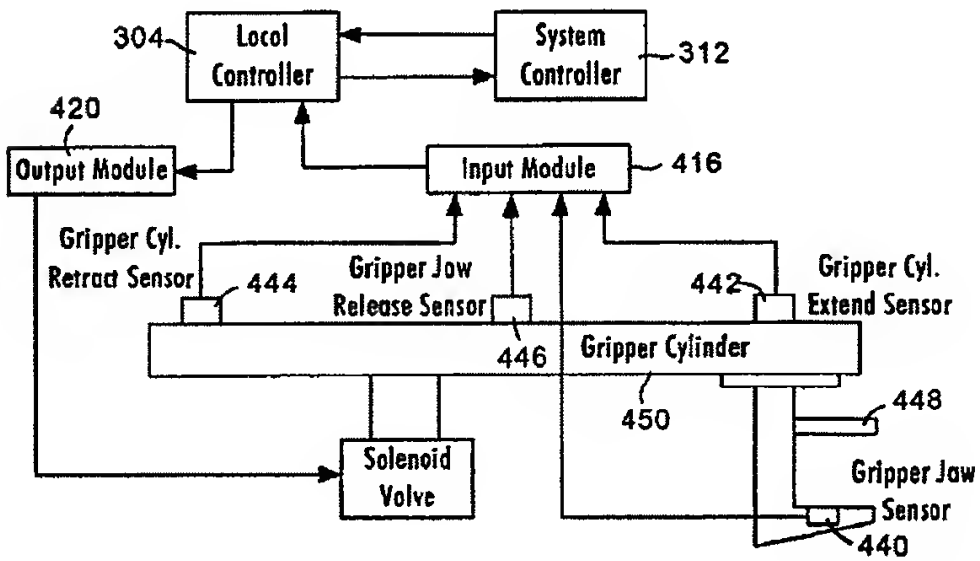

304
Local Controller
System Controller
312
420
Output Module
Input Module
416
Gripper Cyl. Retract Sensor
444
Gripper Jaw Release Sensor
442
Gripper Cyl. Extend Sensor
446
Gripper Cylinder
450
448
Solenoid Valve
Gripper Jaw Sensor
440

Fig. 21

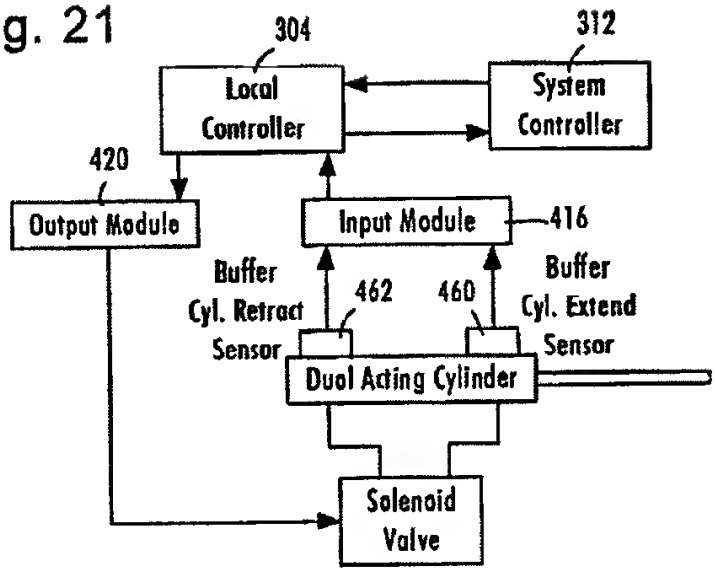
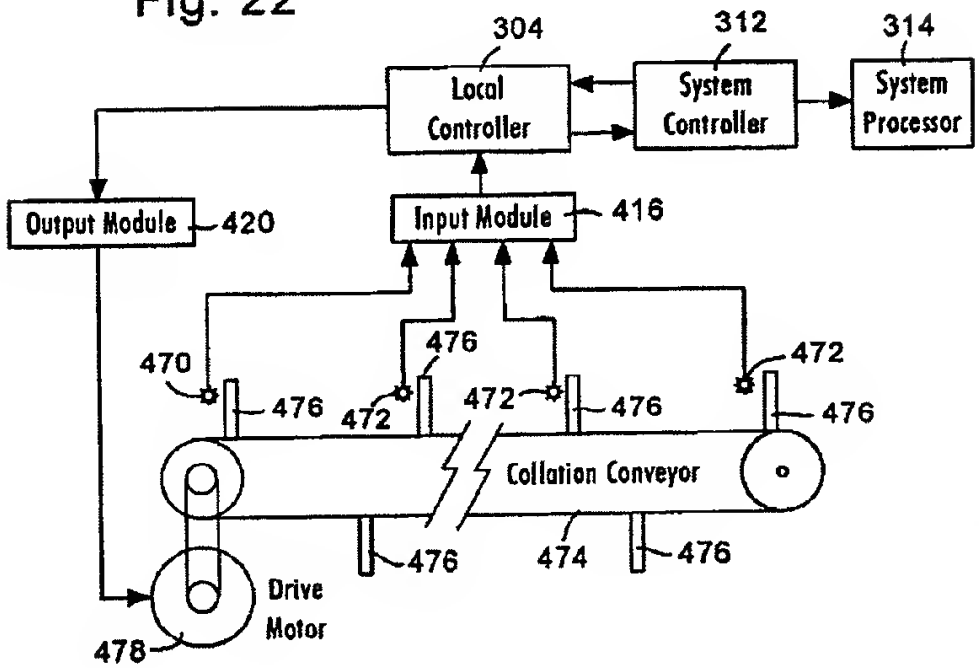

304
312
Local Controller
System Controller
420
Output Module
Input Module
416
Buffer Cyl. Retract Sensor
462
460
Buffer Cyl. Extend Sensor
Dual Acting Cylinder
Solenoid Valve

Fig. 22


304
312
314
Local Controller
System Controller
System Processor
Output Module
420
Input Module
416
470
476
472
Collation Conveyor
474
Drive Motor
478

FLATS BUNDLE COLLATOR

The present invention relates to a flats bundle collator, and particularly to a collator apparatus that will merge separate groups of pre-addressed, similar mail documents imprinted with a POSTNET barcode or delivery point indicia into a stream of mail document groups that are consistently ordered in delivery point sequence, where each document group is to be delivered to a distinct delivery point in sequence along a mail delivery route.

BACKGROUND OF THE INVENTION

The Postal Service is constantly working towards increasing the speed and efficiency in delivering mail. To this end, the processing of mail is increasingly being performed by automatically controlled and operated machinery, which sorts mail in accordance with its ultimate destination for ease and efficiency of delivery to a specific delivery point along a mail carrier's route.

As part of the automation and efficient delivery of the mail, sorter machines have been developed that sort regular mailpieces in a sequence corresponding to the delivery point route used by the mailperson for delivery to individual addresses. An example of a carrier sequence bar code sorter is disclosed in U.S. Pat. No. 5,143,225. However, these machines cannot sort the larger, odd shaped and non-uniform rigid flat mailpieces described below.

Present mail handling systems are designed to process regular mail and/or flat mail, the latter being defined as FSM 881 automation mail in the Domestic Mail Manual. Flat mail ranges from four to fifteen and three-quarters inches in length, from four to twelve inches in width, and from 0.007 to 1.25 inches thick, weighing from 0.01 to 6 pounds. The types of mail in the flat category include, but are not limited to: catalogs, magazines (with or without sleeves or polywrap), newspapers, padded envelopes, single sheet flyers, and compact disks. Currently, there are no known prior art machines that perform sequencing of such flats mail.

A large quantity of flat mail today comprises mass mailings, which may include several thousand or more magazines, catalogs and the like which are delivered to Postal sorting facilities in bundles, each piece within the bundle organized in delivery point sequence, primarily according to an eleven digit POSTNET delivery point designation, with each mailpiece imprinted with a POSTNET barcode representing the delivery point of the mailpiece. The first five digits of the POSTNET barcode identify the post office servicing the area encompassing the designated delivery point, the second four digits identify a zone within the area serviced by the designated post office, and the last two digits identify the distinct delivery point, such as an individual home or an apartment unit in a building, etc. Each bundle of similar mailpieces is prepared by a magazine or catalog publisher, or other mass mailing house, in delivery point sequence according to a POSTNET designation, and then delivered to a postal facility for sortation and further processing. It should be understood however that not all bundles or mailings are comprised of sequenced mailpieces.

Prior to the present invention, such flat mail was sorted by hand by postal employees, and placed in bundles according to delivery points along a mail delivery route. This manual sortation is time consuming and highly labor intensive. Therefore, an apparatus was considered that would automatically receive many bundles of mail documents, each

bundle composed of similar pieces of mail organized by delivery point sequence, which apparatus would merge the documents in each bundle into a discrete new document group, where each new individual group includes mail documents designated for delivery to a single delivery point. Regular mailpieces addressed to the same delivery point are added to each new individual group and the combined mailpieces are placed in a pocket or container in a sequence corresponding to the selected delivery route. The apparatus under consideration would also be capable of adding non-barcoded mail documents to each document group, in a mailing where every delivery point address along a route receives a particular piece of mail.

Therefore, it is an object of the present invention to automate the collation of flat mailpieces, each imprinted with a POSTNET barcode or other delivery point indicia, which mailpieces are received from the publisher of the mailpiece in a delivery point sequence or non-barcoded mailings where every delivery point address along a route receives a particular piece of mail, into a single stream of new document groups and which mailpieces are merged that are consistently oriented and in delivery point sequence for delivery of each new group to a designated delivery point address.

A further object of the present invention is to provide a collator apparatus that permits the rapid feeding of large volumes of bundles of both pre-sequenced and non-barcoded similar flat mailpieces into a sortation system that creates new individual groups of dissimilar mailpieces for delivery of each new group to a single delivery point.

Another object of the present invention is to provide a collator apparatus that captures the image of a delivery point indicia on each piece of flat mail processed by the collator, and transmits that delivery point data to a data processing unit for operational control of the collator.

A further object of the present invention is to provide a flat mailpiece collator comprising multiple feed stations and which can be operated by one person.

Yet another object of the present invention is to provide a document unloading device that rapidly and firmly grips an individual mailpiece in a stack of mailpieces, and transfers the mailpiece for deposit onto a new group of mailpieces addressed to the same delivery point.

Another object of the present invention is to provide a system for rejecting mailpieces which include a delivery point indicia which cannot be read by the image capture device, or which are out of sequence in the original stack of mailpieces.

A further object of the present invention is to provide an apparatus for retaining a mailpiece on a buffer platform until a new group of mailpieces bearing the same delivery point indicia and/or collated to the same delivery point, is advanced by a collation conveyor to a position beneath the buffer platform.

Still another object of the present invention is to provide a collator for merging separate groups of delivery point sequenced mailpieces into a single stream of new mailpiece bundles that are consistently oriented in delivery point sequence, and which collator incorporates a first data processing unit for controlling the collator operation, and a second data processing unit which is used off-line from the collator for software and U.S. Postal Service data network interface development.

A further object of the present invention is to provide an apparatus for merging separate groups of delivery point sequenced bundled flat mailpieces into a single stream of

mailpieces that are consistently oriented in individual new bundles for each delivery point, which apparatus includes a plurality of individual document feed units processing the mailpieces and depositing the mailpieces on a single moveable conveyor system which includes a plurality of pockets, each pocket representing a different and distinct delivery point.

Another object of the present invention is the provision of an automatic unloader for depositing multiple new groups of consistent delivery point addressed mailpieces from a conveyor into containers, where the new groups of mailpieces are arranged in an order corresponding to the sequence of delivery over a predetermined delivery route.

SUMMARY OF THE INVENTION

The present invention relates to an apparatus for collating a plurality of separate groups or bundles of similar mailpieces arranged in a predetermined delivery point sequence, each mailpiece imprinted with a distinct delivery point or address indicia, to provide a single stream of mailpieces in new groups, where each new group comprises a plurality of mailpieces all addressed to a distinct delivery point. The apparatus comprises a plurality of feed units, each unit configured to process a quantity of similar mailpieces, each with a distinct delivery point indicia on the face of the mailpiece, and to deposit each mailpiece in a distinct pocket on a collation conveyor which traverses all of the plurality of feed units. Each pocket will ultimately contain different mail pieces, all addressed to the same delivery point. Multiple new groups of mailpieces are then automatically placed in containers in a sequence corresponding to a predetermined delivery route.

Each feed unit comprises two independently vertically and horizontally moveable document platforms that rapidly and continuously advance large quantities of delivery point sequenced and imprinted mailpieces or documents in a stack to a feed station. An image capture camera obtains the digital image of the delivery point indicia on the topmost mailpiece of the stack, and transmits the data from the image to a data processing unit which controls the operation of each individual feed unit, the operations of the collation conveyor which traverses all of the individual feed units and receives mailpieces from each feed unit, and the operation of the automatic traying apparatus which places delivery point consistent groups of mailpieces in containers corresponding to a predetermined delivery route sequence.

After the image capture camera has captured the digital image of the delivery point indicia on the topmost mailpiece, a suction and gripper mechanism at the feed station of each collator unit engages and removes the topmost mailpiece in each stack of mailpieces advanced to the feed station, and moves the topmost mailpiece to a moveable buffer platform disposed over the collation conveyor. The suction and gripper mechanisms then return to a home position to be ready to engage and remove the next topmost mailpiece. If the data processing unit detects a match between the delivery point of the mailpiece on the buffer platform and the delivery point designation of the collation conveyor pocket directly below the buffer platform, the buffer platform is moved out from beneath the mailpiece on the buffer platform to deposit the mailpiece in the designated pocket on the collation conveyor. If the data processing unit does not detect a match between the delivery point of the mailpiece and the delivery point designation of the collation conveyor pocket directly below the buffer platform, the buffer platform remains in place and the mailpiece is not deposited onto the collation conveyor until a match, as described herein, is sensed upon lateral movement of the collation conveyor across each of the individual feed units.

The buffer platform is capable of movement from a first position over the collation conveyor to a second position over a reject conveyor or platform. If the image capture camera cannot read the POSTNET barcode on a particular mailpiece, or the mailpiece is deemed by the data processing unit to be out of sequence, that mailpiece is retained on the buffer platform as the buffer platform moves to its second position over the reject conveyor or platform. The mailpiece is then retained in place while the buffer platform moves out from under the mailpiece and back to its home position, and the mailpiece is deposited on the reject conveyor or platform. Rejected mailpieces are then manually added to the appropriate bundle of similarly addressed mailpieces.

A retractable finger assembly is adapted to ride in corresponding grooves in the buffer platform, and engages either the leading edge or trailing edge of the mailpiece when the data processing unit commands the collator to retain the document on the buffer platform as the buffer platform moves out from under a mailpiece. The finger assembly is also retractable away from the buffer platform to allow a mailpiece to remain on the buffer platform as the platform is moved from its position above the collation conveyor to its position over the reject conveyor.

The collation conveyor of the present invention comprises an endless belt extending in a continuous run past each of the plurality of feed units. Substantially vertically extending fingers disposed on the collation conveyor belt define sequenced pockets on the conveyor, each pocket identified in the data processing unit with a distinct delivery point address. Therefore, as each pocket of the collation conveyor arrives at the end of the conveyor belt run, each pocket contains a group of dissimilar mailpieces all collated to the same delivery point. The groups are then automatically placed in containers for delivery pursuant to a predetermined route sequence.

At the end of the collation conveyor, which now supports a new group of mailpieces in individual pockets, each pocket comprising mailpieces for one designated delivery point address, a system is provided to load each new group into containers in a sequence corresponding to a predetermined delivery route.

DETAIL DESCRIPTION OF THE DRAWINGS

A fuller understanding of the foregoing may be had by reference to the accompanying drawings wherein:

FIG. 1 is an elevation view of a multi-station flats bundle collator constructed in accordance with the present invention;

FIG. 1A is a perspective view of the flats bundle collator of the present invention;

FIG. 2 is a top plan view of the multi-station flats bundle collator of FIG. 1;

FIG. 3 is an end view of one of the feed stations comprising the flat bundle collator shown in FIG. 1, taken along the line 3—3 in FIG. 1;

FIG. 4 is a front perspective view of the feed stack support paddles and stack support paddle mounting shafts and drive belts for the stack support paddles forming part of the present invention;

FIGS. 4A, 4B and 4C are schematic perspective views of the pivotal and vertical movement of the stack support paddles of the present invention, showing in FIG. 4B the

latch on the support paddle which engages the drive belt (FIG. 4C) which elevates the support paddles and controllably drives the support paddles in an upward direction, and showing the movement of an empty support paddle to a new position beneath a full support paddle, whereby the lower support paddle is positioned to accept a new stack of documents;

FIG. 5 is a detail perspective view showing the unidirectional and pivotally detachable mounting between the stack support paddles and the paddle drive belt of the present invention;

FIG. 6 is a detail front elevation view of one feeder module mechanism of the flats bundle collator forming the present invention, showing the document picker assembly and stack support paddles, and their respective mounting elements;

FIG. 7 is a detail partial side elevation view of the flats bundle collator comprising the present invention showing the two end positions of the buffer platform;

FIG. 8 is a top plan view of two buffer platforms in a single feed station of the collator of the present invention;

FIG. 9 is a front elevation view of the two buffer platforms in each feed station of the collator of the present invention;

FIG. 9A is a perspective view of a buffer plate sensor as an alternative embodiment to the gripper jaw sensor of the present invention.

FIG. 10 is a detail front perspective view of the document suction picker assembly of the present invention and a partial front perspective view of the gripper assembly of the present invention extending outwardly from a slot in the suction picker assembly;

FIG. 11 is a detail side elevation view of the extended and home positions of the gripper assembly and air cylinder mount of the present invention with the gripper jaw shown in its open position and, in phantom, in its closed position; taken along the line 11—11 in FIG. 10;

FIG. 12 is detail partial side view of the flats bundle collator of the present invention showing the relative location of the buffer platform and for the reject gate;

FIG. 13 is an end partial perspective view of the system of feed stations of the present invention, taken generally along line 13—13 of FIG. 1;

FIGS. 14A through 14F are side elevation schematic drawings showing the sequence of operation of the buffer platform and reject gate of the present invention;

FIG. 15 is a block diagram of the control system for the flats bundle collator of the present invention;

FIG. 16 is a flowchart illustrating the overall operation of one embodiment of the present invention;

FIG. 17 illustrates the overall system architecture for the system processor 20 of the present invention;

FIG. 18 illustrates the functioning of the infeed mail stack sensor of an embodiment of the present invention;

FIG. 19 illustrates the functioning of the picker assembly cylinder extend and retract sensors of the present invention;

FIG. 20 illustrates the functioning of the gripper jaw, gripper cylinder extend, gripper cylinder retract, and gripper jaw release sensors of the present invention;

FIG. 21 illustrates the functioning of the buffer platform cylinder extend and buffer platform retract sensors of the present invention; and

FIG. 22 illustrates the functioning of the index or finger sensors and stack height sensors of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

While the invention is susceptible of embodiment in many different forms, there is shown in the drawings and will be described herein in detail a preferred embodiment of the invention. It should be understood however that the present disclosure is to be considered an exemplification of the principles of the invention and is not intended to limit the spirit and scope of the invention and/or claims of the embodiment illustrated.

Referring to FIG. 1, four read-feed modules of the flats bundle collator 10 constructed in accordance with the present invention is illustrated. Each read-feed module assembly 12 comprises two feed stations 14, 16 in side by side alignment.

The present invention contemplates any number of read-feed module assemblies 12 in a side by side array, depending upon the number of incoming stacks of mailpieces that are to be collated for a given mail route run. By way of example, it is presently contemplated that eight read-feed module assemblies 12, providing sixteen feed stations 14, 16 would be aligned in a typical flat mail processing facility.

As described below in more detail, each feed station 14, 16 is adapted to receive an incoming stack 17 of flat mailpiece documents 19 (FIG. 3), wherein each mailpiece document 19 in a given stack 17 is imprinted with a POSTNET eleven digit barcode defining a distinctive delivery point address, or other readable code or symbol, wherein each delivery point is a specific home, apartment, condominium, building, or the like, to which mail is to be delivered to a customer. Each delivery point address or barcode is readable electronically, such as by a barcode reader, closed couple device (CCD) camera, or other image capture or read device that is capable of transforming the address barcode or symbol into a digital or other image for processing by a data processing unit. In the illustrated embodiment of the barcode, the image of which is captured digitally, and processed by a data processing unit, as will be explained.

The present invention contemplates that each mailpiece document 19 in an incoming stack 17 of documents will be provided in a predetermined sequence, for example in an order corresponding to the delivery point sequence defined by the route used by a delivery person to deliver mail to each customer on the route.

In one embodiment of the present invention, as seen in FIGS. 1 and 2, a collation conveyor 18 comprising an endless belt 20 extends along the entire length of the plurality of feed stations 12. A plurality of fingers 22 are attached to and extend substantially perpendicular from the surface of belt 20 to form a plurality of pockets 24 on the belt 18 between adjacent fingers 22. Belt 18 extends around driven roller 26 and idler roller 28, and a motor 30 is operatively connected to the central shaft 32 of roller 26, whereby activation of motor 30 drives roller 28 and the upper run of belt 18 in the direction shown by arrow A in FIGS. 1 and 2.

As shown in FIG. 1, the flat bundle collator 10 may also include a reject conveyor 34 which deposits rejected mailpieces into a reject container 36, as will be explained. Collated groups of mailpieces, with each group to be delivered to a specific delivery point, are deposited from collation conveyor 18 into a tray 38, which is part of either a manual or automatic traying system or module (not shown, but disclosed in co-pending U.S. patent application entitled "Flats Mail Autotrayer System" filed concurrently herewith, and herein incorporated by reference), and which ensures that all collated groups of mailpieces are available, as groups, for delivery to the delivery point indicated on each mailpiece in a group.

FIG. 3 is a cut-away side schematic illustration of one of the read-feed modules 12 illustrated in a sequential array in FIGS. 1 and 2. The mechanical and electronic components of each read-feed module, to be explained in further detail, are mounted on a frame 40, having a slanted forward facing frame member 42. The frame 40 is mounted on a floor 44 or other supporting surface by means of adjustable levelers 46. Frame 40 also comprises a rear vertically extending frame member 48 to which components of the present invention are mounted, as will be explained.

An infeed magazine assembly 50 is mounted on forward facing frame member 42, which supports stack 17 of mailpieces 19 (FIGS. 3, 4A, 4B, 4C) which are fed facing upwards towards a mailpiece feed position/station 52, where the delivery point barcode, or other code applied to the topmost mailpieces in each stack 17 are sequentially imaged and then removed from the stack of mailpieces for collation or rejection. In the illustrated embodiment, the term "imaged" means electronically obtaining an image of the POSTNET barcode (or other code) on each mailpiece, where the electronic image is processed further, as will be explained.

Referring to FIGS. 3 and 4, a pair of spaced apart side mounting plates 54, 56 extend vertically along and are fixed to the slanted frame member 42. A bottom bracket 58 (FIG. 3) mounted to frame 40 is also fixed to side mounting plates 54, 56 for additional vertical support. For each feed station 14, a pair of guide shafts 60, 62 are mounted vertically on side mounting plates 54, 56 by brackets 64, or other known means. A cylinder 66, 68 is slidably and rotatably mounted on each guide shaft 60, 62 respectively. A mail stack support paddle 70, 72 is rigidly fixed to respective cylinders 66, 68, for vertical movement of paddles 70, 72 along guide shafts 60, 62, respectively, and for horizontal pivotal movement of each paddle about its respective guide shaft. Each paddle 70, 72 has a relatively pointed forward end 74 (FIG. 3), and a knob or handle 76 on the rear end of each paddle.

A pair of jointly moveable mailpiece stack centering guides 78 (FIG. 6) are mounted on a panel plate 79 attached to side plates 54, 56, and include outwardly extending flanges 80. As each stack 17 of mailpieces 19 are advanced upward along slanted frame member 42 as will be explained, the forward edges of the mailpieces are engaged by flanges 80 to maintain the alignment of the mailpieces as they approach upwardly advance and feed station 52. Guides 78 are mounted on mounts (not shown) on the opposite side of plate 79 which extends between side mounting plates 54 and 56. Guides 78 move laterally along slots 81 until the distance between opposing flanges 80 is equal to the lateral dimension of the stack 17 of documents 19 on support paddles 70 and 72.

A belt drive assembly 82 (FIGS. 3, 4) is mounted on the outer sides of each side mounting plate 54, 56 to drive mailpiece support paddles 70, 72, respectively, vertically upwards towards feed position/station 52. Belt drive assembly 82 comprises a belt 84 which incorporates ridges 86 (FIGS. 3, 4, 5) on the outer surface of the belt, such as a timing belt. As seen in FIGS. 3 and 4, the belt 84 extends around a plurality of idler rollers 88, and around a drive roller 90 mechanically connected to a controllable motor 92. Motor 92 drives belt 84 in the direction indicated by arrow B in FIG. 3. Beneath the forward facing run of belt 84 is an elongated backing block 94 (FIGS. 3, 4), and the underside of belt 84 runs along the forward face of backing block 94.

As illustrated in FIG. 5, each cylinder 66, 68 has a U-shaped bracket 96 affixed thereto, with a bolted pin 98 extending between the ends of the bracket. A pivotal latch 100 is mounted on pin 98 between the ends of the U-shaped bracket 96 for partial angular pivotal motion about the pin 98. The lower end of latch 100 includes a flange 102 extending from the latch 100 towards belt 84, which flange has a substantially pointed tip 103. A spring element (not shown) may be mounted on bracket 96 to urge latch 100 in a direction away from cylinder 66 and towards belt 84, such that pointed tip 103 engages a groove between adjacent ridges 86 of belt 84. As viewed in FIGS. 3 and 5, upon actuation of motor 92, belt 84 is driven upward in the direction B and is buttressed against backing block 94. Either the spring or the equilibrium balance position of latch 100 maintains contact between pointed tip 103 of flange 102 of latch 100, and one of the ridges 86 of belt 84. Cylinder 66 and support paddle 70 can then be driven upward by belt 84 and the associated ridge.

As seen in FIGS. 4 and 5, each support paddle 70 (and 72) comprises a forward facing plate 104 which is securely affixed to cylinder 66 (or 68), such that if cylinder 66 and 68 rotates horizontally about guide shafts 60, 62, respectively, plate 104 and the respective support paddle 70, 72 will also rotate with cylinder 66 or 68. In FIG. 5, the connection between plate 104 and cylinder 66 is shown as weld 106, however it is understood that any suitable means of fixation of plate 104 to cylinder 66 (or 68) is within the scope of the present invention. Additionally, as cylinder 66, 68 move vertically along guide shafts 60, 62, support paddles 70, 72, respectively, also move vertically with cylinders 66 or 68.

The relative movements of support paddles 70 and 72 are illustrated in FIGS. 4A, 4B and 4C. In this illustrative description, support paddle 72 is disposed above support paddle 70 (FIG. 3), and it is presumed that all of the documents 19 have been removed from paddle 72, as will be explained. By manually grasping knob 76 (FIG. 4A), upper support paddle 72 may be rotated outward (arrow C) as cylinder 68 rotates around guide shaft 62. Upon the counter clockwise rotation of support paddle 72, as seen in FIG. 4, pointed tip 103 of flange 102 becomes disengaged from between adjacent ridges 86, of belt 84 as the pointed tip 103 of the flange 102 slides laterally away from ridges 86, and cylinder 68 and support paddle 72 may be manually moved vertically up or down to a new position along guide shaft 62. A similar latch 100 and flange 102 assembly is operatively connected to cylinder 66 and support paddle 70. Thus, the description of the movements of cylinder 68 and support paddle 72 are equally applicable to describe the movements of cylinder 66 and associated support paddle 70.

As seen in FIG. 4A, support paddle 72 is rotated counterclockwise more than ninety degrees from the position shown in phantom in FIG. 4A, so that the pointed end 74 of paddle 72 is clear of the stack 17 of documents 19 that are lodged on lower support paddle 70 (FIG. 4C). By using knob or handle 76, cylinder 68 and paddle 72 are lowered as indicated by arrow D in FIG. 4B to a position where paddle 72 is beneath support paddle 70. As seen in FIGS. 4A and B, support paddle 70 has been loaded with a stack 17 of documents 19, which was disposed below the stack of documents on paddle 72 as paddle 72 was previously unloaded of its documents 19, one by one, as will be explained.

When empty support paddle 72 is substantially below loaded support paddle 70, paddle 72 is rotated clockwise, as indicated by arrow E in FIG. 4B, until support paddle is in the position shown in FIG. 4C. As support paddle 72 rotates into the position shown in FIG. 4C, the tip 103 of flange 102 (FIG. 5) moves laterally in between two adjacent ridges 86

of belt 84. As explained previously, by the use of a spring or other resilient member, or by the equilibrium balance position of latch 100, upward movement of belt 84 will cause tip 103 of flange 102 to be engaged by an adjacent ridge of belt 84, whereby bracket 96, plate 104 and support paddles 70 and 72 will be advanced upward by drive motor 92 and belt 84.

When support paddle 72 is re-located to its position as shown in FIG. 4C, and is operatively engaged through latch 100 to belt 84, the support paddle 72 is loaded with a stack 17 of documents 19 for upward movement and subsequent collating as will be explained. It is understood that each stack 17 of documents 19 placed on support paddles 70, 72 in a single feed station 14 or 16, for a single mail distribution run or carrier route, comprises similar documents 19 which differ only in that the POSTNET or other barcode or delivery point designation on each document is different, and these designations are in sequence accordance with the pre-established delivery route.

In one embodiment of the present invention, a stationary platform 108 may extend between side mounting plates 54, 56 at the lower end of frame 40 and facing towards the front of flats bundle collator 10. If desired, referring to FIGS. 4A and 4B, prior to moving support paddle 72 to its position shown in FIG. 4C, a stack 17 of documents 19 in sequential delivery point order may be placed on stationary platform 108. As support paddle 72 is rotated in the direction shown by arrow E (FIG. 4B), the pointed end 74 of support paddle 72 wedges between adjacent documents 19 on platform 108. Those documents 19 on paddle 72 will be advanced upward toward feed station 52, while those documents below paddle 72 will remain on platform 108. When additional documents 19 are placed on platform 108, care must be taken to place these documents beneath the documents remaining on platform 108 so that the delivery point sequence is maintained.

As will be explained, controllable motor 92, preferably drives belt 84 incrementally, as will be explained, in the direction shown by arrow B in FIG. 3. At a point adjacent to each mailpiece feed position/station 52 in each read-feed module 12, (FIG. 3), an infeed mail stack sensor 410 (FIGS. 1, 3, 6, 18) is disposed on a support wall 79 (FIG. 10), and is electronically connected to the control system for the infeed paddle drive motor 92 (FIG. 18). As will be explained in more detail, as each support paddle 70, 72 is driven upward by motor 92 and belt 84, the motor stops when sensor 410 detects the uppermost document 19 in its respective stack 17. At this point, the uppermost document 19 is in the proper position for further processing and collating.

As stated previously, a digital image of the POSTNET barcode, or other delivery point address or code, on the topmost document 19 in each stack 17 is captured and forwarded electronically for processing. The timing of such image capture is controlled by the feeder sequence. In the illustrated embodiment, and with reference to FIG. 3, the image capture device is a closed couple device (CCD) camera assembly 110 (FIG. 3). Camera assembly 110 comprises a CCD camera 112, such as XC-55 manufactured by Sooy, disposed in a camera housing 114. Mounting shaft 116 extends between housing 114 and a universally pivotal ball-joint suspension assembly 118. Suspension assembly 118 is fixedly mounted to frame 40 by means of bracket 120. The ball joint portion of suspension assembly 118 comprises a ball 122 fixed to the upper portion of shaft 116, and a pair of adjustable plates 124, 126 having cavities therein to engage either lateral side of ball 122. A manually operable tension adjusting device 128 allows the gripping tension on ball 122 to be loosened while camera housing 114 and camera 112 are adjusted into any position.

As viewed in FIG. 3, the lower end of camera housing 114 includes a pair of lasers 130, 132, each of which emits a separate light beam 134, 136. The lasers 130, 132 are calibrated such that as each beam 134, 136 is cast upon the topmost document 19 in upper stack 17, the distance between each light beam is approximately two and one-half inches, which approximately corresponds to the lateral distance from one end to another end of the POSTNET barcode on each document 19. Since each documents 19 in a given mailing is prepared in the same format, the barcode will appear in the same approximate location and have the same orientation on each document in that mailing. Thus, the position of camera 112 manually does not have to be re-oriented during the processing of the documents 19 comprising that given mailing. When a stack of new documents 19 to be collated is introduced to a feed station 14, 16 of collator 10, the camera housing 114 is re-oriented to its proper position as described above. In this manner, camera 112 can be positioned to capture a delivery point barcode on a document 19 regardless of the position or orientation of the barcode on the document.

Camera 112 captures a digital image of the address or delivery point barcode on each document 19, and transmits that information through electrical connection 129 to the data processor system illustrated and described in conjunction with FIGS. 16 and 17 herein. As seen in FIG. 1A, opposed lamps are used to illuminate the mailpiece evenly for optimal image capture, with each lamp illuminating an opposite one half of the mail piece. A lamp baffle is located proximate each lamp to prevent glare from one lamp on the portion of the mailpiece closest to that lamp, i.e., to prevent glare or "hot spots" on the portion of the mailpiece not being illuminated by that lamp. Further an overhead light shield 600 is provided to prevent glare from overhead lights.

Immediately after capture of the image of the barcode on the topmost document 19 of a stack 17, which document is positioned at mailpiece feed position/station 52, the topmost document 19 is automatically and individually removed from its respective stack and advanced for either collation or rejection. To sequentially remove each document 19 from its respective stack, a document picker assembly is provided, as shown in FIGS. 3 and 6. Picker arm assembly 133 comprises a moveable plate 135 (FIGS. 3, 6, 10) which has a pair of lateral flanges 137, 138 to which a plurality of suction picker assemblies 140 are mounted. A pair of fingers 141 are provided to impart a curl or bend in the mailpiece being picked up, to ensure that only the top mailpiece is picked up, i.e., due to the bend, if a lower mailpiece sticks to the mailpiece being picked up, the bend will cause the two mailpieces to separate.

FIGS. 10A and 10B illustrate an alternate embodiment of the picker assemblies 140, wherein the fingers 141*a* are spring loaded so that they can be placed in two positions, an upper position as shown in FIG. 10A when engaged by a latch 142, and a lower position as shown in FIG. 10B when the latch 142 is retracted. The operator can select the different finger positions depending on the type of mailpieces being picked up.

FIG. 15 illustrates a block diagram of the overall control system 300 for the flats bundle collator 10. Each feed station 14, 16 is operably connected to its own local controller 304. As described previously, two individual feed stations 14, 16 for each read-feed module 12, and the present invention may comprise any number N of read-feed modules 12. Alternatively, each read-feed module 12 may comprise a single feed station, or more than two read stations. Generally, each feed station 14, 16 has multiple I/O modules

310 via which the feed stations 14, 16 communicate with the local controllers 304. In addition, the collation conveyer and autotrayer have their own I/O module 310 (FIG. 37)

The local controllers 304 are each connected to a high speed serial network which is connected to the system controller 312. The system controller 312 is then connected to the overall system processor 314 via a serial communication line. In general, the system controller 312 communicates with the system processor 314 to pass status information from the local controllers 304 to the system processor 314 and to pass machine control instructions from the system processor to the system controller 312. The local controllers 304 receive machine control information from the system controller 312, and based on this information, the local controllers 304 control the mechanical operation of their corresponding feed stations 14, 16. In addition to controlling the stations 14, 16, the local controllers 304 may also perform certain independent local processing without intervention of the system controller 312.

The system processor 314 may be a personal computer ("PC") with which a user (e.g., the operator) may interface for providing any necessary inputs to the system. This interface may be, for example, a graphical user interface ("GUI"). Via the user interface, the operator may input to the system processor 314 information including, for example, Sort Plan information, carrier route information, and/or other pertinent data for processing and/or collating the mail. The system processor 314 may also have the ability to collect statistical information relating to the flats bundle collator 10 operation, and to generate reports (e.g., end-of-day or end-of-run reports) based on this statistical information. The statistical information collected by the system processor 314 may include, for example, the number of errors or faults, the number of flats processed by each feed station 14, 16, the number of flats fed, the number of flats collated, the number of missorted flats, the number of flats without a barcode, or the total number of cycles administered.

FIG. 16 is a flowchart 320 illustrating the overall operation of one embodiment of the present invention. Before the machine begins operation, the operator generally carries out an initialization process 322. This initialization process may include loading the flats bundles in a feeder stack on the support paddle 70 (FIG. 1). The initialization process may also include providing sort plan information to the system processor 314 (FIG. 15). The sort plan information generally comprises information such as, for example, the particular sorting plan which the processor should follow, including the delivery route identification, and the delivery route sequence to be followed. As explained below, when the collation conveyor belt is advanced, a sequence number is assigned to the new collation pocket introduced at the first feed station.

The initialization process 322 may also include adjusting the image capture camera to properly aim at the bar code location of the present set of flats. One way to aim the image capture camera, as discussed previously, may be to use two laser pointers to align the image capture area with the barcode and center the barcode within the image capture area. In general, the delivery sequence barcodes used by the U.S. Postal Service are approximately 3 inches long. Thus, in order to allow a certain amount of error in the positioning of the barcode, the image capture area may be larger than three inches long (e.g., 4"×6").

After the machine is initialized, operation may begin by, for example, activating a "start" actuator or button 324. The present description of the operation will be with respect to one individual feed station 14, 16. However, it will be appreciated that each station 14, 16 follows the detailed operation simultaneously and independently. Upon starting the machine, visual and/or audio warning signals may be activated 326 indicating that the machine is about to start. First, all of the feeders are set to their home positions 328. Next, an image of the barcode of the piece of mail on the top of the stack of the top support paddle 72 is captured by the camera 112. This image capture step may be triggered by, for example, a "ready capture" message from the system controller 312 (FIG. 30) to the system processor 314. The "ready capture" message will indicate the particular feed station (or stations) 14, 16 that is (are) ready for image capture. The captured image is then processed and the barcode decoded 332 by the system processor 314 which generates a code number associated with the present piece of mail. This code number may be, for example, an eleven digit value representing the delivery point of the present piece of mail. However, for different applications of the present invention, the code value may vary. For example, for use in a smaller company's mail room, the code value may be a two-digit value identifying a particular department.

After the picker picks up the next piece of mail, the gripper grabs that piece of mail and pulls it onto the buffer platform 336. A new piece of mail is now on the top of the feeder stack, and thus the system processor 314 may capture the next barcode image 338. This may, again, be indicated by a "ready capture" message from the system controller 312 to the system processor 314.

At the same time that the next image is being captured and decoded, the system controller 312 may check for a fault at the feed station 14 or 16 (step 340). If a fault has occurred the machine stops 342. Various fault situations are described in further detail below. If a fault has not occurred, the system processor 314 checks the decoded barcode number corresponding to the present piece of mail on the buffer platform to determine whether the feed station 14, 16 should reject the piece of mail 344. A rejection may occur when, for example, the barcode is unreadable, the barcode is out of sequence, or a double feed has occurred. If any of these situations is present, the system processor sends a "reject" message to the system controller 312, and the system controller 312 instructs the local controller 304 to reject the piece of mail 346. The rejected mailpiece then is not dropped to the collation conveyor, but instead is moved by the buffer platform in a position over the reject conveyor, where it is then dropped onto and conveyed to the reject container. The reject conveyor is preferably driven in a direction opposite of the conveyor assembly. The system controller 314 then sends a "cycle complete" message to the system processor 312 (step 348), and then the next feeder cycle begins, picking up the next piece of mail on the feeder stack, and pulling the piece of mail onto the buffer platform 336.

If the current piece of mail on the buffer platform is not rejected, the system processor 314 determines whether the barcode for this piece of mail corresponds to the collation pocket currently positioned under the buffer platform 350. If there is a match, the system processor 314 instructs the system controller 312 to transfer the piece of mail, and the system controller 312 accordingly instructs the local controller 304 to transfer the piece of mail to the collation pocket 352. Based on a signal received from a "stack height" sensor 42 at each collation pocket, the feed station 14, 16 sends a signal to the system controller 312 if the collation pocket 24 is full 354. If the "stack height" sensor does not indicate a full pocket, the system controller 312 may check

for any faults in the read-feed module 14, 16 (step 356). If there is a fault, the machine stops 358. If there are no faults, the system controller 312 sends a "cycle complete" message to the system processor 314 (step 360), and then the next feed cycle begins, starting with determining if the buffer platform is empty 334, picking up the next piece of mail on the feeder stack, and pulling it onto the buffer platform 336.

If the collation pocket is full after the current piece of mail is transferred to the pocket, the "full pocket" mode of operation is activated 362. In accordance with a preferred embodiment of the present invention, in the "full pocket" mode of operation, the system processor 314 may be set up such that the particular barcode number assigned to the full conveyor pocket will be reassigned to a new collation pocket. Thus, any future pieces of mail that would have been transferred to that conveyor pocket will now be transferred to the reassigned conveyor pocket. Alternatively, the system processor 314 may simply indicate that any future pieces of mail with the barcode number assigned to the full pocket will be rejected.

If the system processor 314 determines there is no match between the barcode for the current piece of mail and the conveyor pocket positioned below the buffer platform, the piece of mail is held on the buffer platform.

Once the system processor 314 determines there are no matches at any of the feeder locations 350, the system controller 312 instructs the collation conveyor to index or advance one place forward 364. The sensor functions associated with this mechanical operation are described in detail below. When the collation conveyor advances, the autotrayer (not shown) is actuated 366. Also when the collation conveyor advances, a new collation pocket is introduced to the first feeder. This new collation pocket is assigned a corresponding sequence number 368. The system processor 314 again determines if there are any matches between the barcodes of the current pieces of mail on the buffer platforms, and the new collation conveyor pockets respectively beneath them (step 370), and the process described above with respect to whether to transfer the flat to the collation conveyor pocket (steps 352–362) or wait and then advance the collation conveyor belt (steps 364–370) repeats.

For purposes of simplicity, the present detailed description describing the flowchart of FIG. 16 identifies two places where the machine checks for faults (steps 340 and 356). However, it will be appreciated that to one with skill in the art, it would be a simple task to check for faults at other stages of the process. For example, a fault-check may occur between steps 346 and 348, or between steps 352 and 354. In a preferred embodiment, a step of checking for faults would occur at any stage in the process where a fault may be likely to occur.

FIG. 17 illustrates the overall system software architecture 380 for the system processor 314. The system software 380 includes several software modules for implementing various operations. The Feeder Control Module 382 acts as the interface between the system controller 312 and the various other modules of the system processor 314. This is the only module that communicates with the system controller 312. For example, the Feeder Control Module 382 will receive commands from the Sort Plan Tracking Module 396 (described below) to initiate a new cycle. The Feeder Control Module 382 also provides messages from the system controller 312 to the Main Router Module 384 (described below) which will forward these messages to the appropriate module or modules on a first-in first-out ("FIFO") basis.

The Main Router Module 384 is responsible for routing all messages to and from the feed stations 14, 16 and the various other modules of the system software application 380. For example, when the Feeder Control Module 382 receives a "ready capture" message from a particular feed station 14, 16 via the system controller 312, the Feeder Control Module 382 sends the ready capture message to the Main Router Module 384 which stores it in a FIFO queue until the message is ready to be forwarded to the Image Capture Module 386. Generally, a "ready capture" message for a particular station 14, 16 is sent by the system controller 312 to the Feeder Control Module 382 when that station 14, 16 is ready for image capture.

The Image Capture Module 386 receives the "ready capture" message from the particular feed station 14, 16, and then executes an image capture algorithm for the appropriate camera. Generally, this image capture algorithm includes instructing a frame grabber 388 to activate the appropriate camera and "grab" or capture the corresponding image. In a preferred embodiment of the present invention, there are three frame grabbers 388, each of which is assigned to one or more feeder cameras. In general, the frame grabbers 388 can only grab one image at any given time, so the Image Capture Module 386 may include a FIFO buffer to chronologically store "ready capture" messages until they are ready to be executed. Once the image is captured, the Image Capture Module 386 sends a "capture complete" message to the Image Process Module 390 (via the Main Router Module 384), and stores the digital image data to an Image Buffer Manager to wait to be processed.

The Image Process Module 390 processes and decodes the captured image, and outputs a multi-digit code corresponding to the bar code on the piece of mail. The bar code is stored in a Code Buffer 394 while an "image decoded" message is sent to the Sort Plan Tracking Module 396 via the Main Router Module 384. In one embodiment of the present invention, the Image Process Module 390 may only be able to process one image at a time. In such an embodiment, the Image Process Module 390 may have a FIFO queue in which to store the incoming "capture complete" messages while an image is being processed and decoded.

The Sort Plan Tracking Module 396 is responsible for storing the sort plans in memory, tracking the collation pockets on the collation conveyor belt, and tracking the delivery points of mail from the feed stations 14, 16. In a preferred embodiment, the Sort Plan Tracking Module 396 is able to keep track of two delivery points for each station 14, 16. The first delivery point is that of the mail piece on the buffer platform waiting to be dropped, and the second delivery point is that of the mail piece on top of the stack on the feeder platform. The Sort Plan Tracking Module 396 processes all of the delivery points associated with mail-pieces processed and assigns each collation pocket to one of these delivery points. In a preferred embodiment, the Sort Plan Tracking Module 396 may be able to assign more than one collation pocket to a single delivery point. Where there are multiple collation pockets for a given delivery point, mail pieces destined for that delivery point will fill the lead pocket first, and then cascade into subsequent pockets as needed. If more mail is present with a particular delivery point than the pocket or pockets assigned to that delivery point can handle, the overflow mail may be rejected. Similarly, if a mail piece's delivery point barcode value could not be read by the system processor 314, it may also be rejected. Also in a preferred embodiment, the mail stacks loaded onto the support paddles 70, 72 of each station 14, 16 will be in sequential order.

As explained above, when the Image Process Module 390 finishes decoding the digital image from an image capture event, it sends an "image decoded" message to the Sort Plan Tracking Module 396. This "image decoded" message identifies the location in the Code Buffer 394 where the output code is stored, as well as the feed station 14, 16 with which the "image decoded" message is associated. Based on the appropriate output code from the Code Buffer 394, information from the "image decoded" message, and the location of the collation pocket corresponding to the delivery point of that bar code, the Sort Plan Tracking Module 396 determines whether the mailpieces should remain on the buffer platform, fall into the collation pocket directly beneath the buffer platform, or be rejected. This determination results in a "hold-accept-reject" message from the Sort Plan Tracking Module 396. The "hold-accept-reject" message is then sent to the Feeder Control Module 382 via the Main Router Module 384, and then to the system controller 312.

The Statistics Logging Module 398 tracks and stores all statistics generated by the system processor 314. The other modules will send messages to the Statistics Logging Module 398 as needed and as generated. Table 1 below illustrates the possible statistics that may be logged by the Statistics Logging Module 398, including the source module from which the statistics are received.

TABLE 1

STATISTIC	DESCRIPTION	SOURCE MODULE
Cycle Count	The number of complete feed cycles for the system.	Feeder Control Module
Mail Pieces Fed	Number of mail pieces fed into the system.	Feeder Control Module
Mail Pieces Rejected	The number of mail pieces rejected by the system for any reasons.	Sort Plan Tracking Module
Images Captured	The number of images captured by the system for all feed stations.	Image Capture Module
Images Processed	The number of images successfully processed by the Image Processing Module	Image Processing Module
Barcodes Resolved	The number of images that were successfully decoded.	Image Processing Module
No Barcode Found	The number of images where the decoder was unable to locate a barcode.	Image Processing Module
Invalid Barcode	The number of barcodes that were not within the sort plan.	Image Processing Module
Overflow Pockets	The number of pockets that were filled to capacity.	Sort Plan Tracking Module

The above statistics are only examples and the invention is not limited to these statistics. The Graphical User Interface ("GUI") Module 400 is responsible for all user interfacing with the system processor 314. User inputs may be provided to the GUI Module 400 via, for example, a keyboard or touch screen monitor or mouse. These user inputs may include, but are not limited to, the particular sort plan or plans to be applied, the particular carrier route or routes being processed, print commands, and other control commands. The print commands may include, for example, a command to print an end-of-run report or end-of-day report of statistics generated by the Statistics Logging Module 398.

Finally, the present invention may comprise a separate Test Module 402, for testing various operations of the machine. The Test Module 402 may be used to carry out various desirable tests of the machine, either from time to time or routinely. The Test Module 402 sends and receives signals and messages between the GUI Module 400 and the system controller 312 (via the Feeder Control Module 382). For example, the user-operator may want to test the infeed paddle drive motor of feeder number "N" to determine if it is working properly. The user-operator would send an instruction via the GUI Module 400 to the Test Module 402 indicating that a test of feeder N's infeed paddle drive motor is desired. The Test Module 402 would then so instruct the system controller 312 which would instruct the corresponding local controller 304 to run the predetermined test routine.

As explained above, in a preferred embodiment of the present invention, each feed station 14, 16 has its own local controller 304 with a series of inputs and outputs (I/O Modules 310), and the individual local controllers 304 are connected to a main system controller 312 which generally controls the overall system. The local controllers 304 in the embodiment described herein are generally "unintelligent" logic controllers with little to no processing or programming capabilities. These local controllers 304 generally send most or all of the input signals they receive to an external processor (i.e., the system controller 312) which processes those signals and in turn sends specific instructions to the individual local controllers 304. However, the present invention may alternatively use "intelligent" local controllers which may process some or all of the input signals on their own, without having to send them out to an external controller.

As explained above, there are numerous sensors used by the present invention. Many of these sensors may be used to detect fault conditions which may require stopping a particular feed station 14, 16, or the entire machine. In the present embodiment, upon sensing a particular condition, the sensors generally send a sensor signal to an input module of the corresponding local controller 304. The local controller 304 then forwards that sensor signal to the system controller 312 which processes the sensor signal and, based on the sensor signal, either sends an appropriate instruction to the local controller 304 (which then carries out the instruction), shuts down all or part of the machine, and/or sends an appropriate message to the system processor 314. If it is a fault that has been sensed, the system processor 314 may notify the user-operator (via the GUI Module 400) that a fault has occurred, and where in the system the fault occurred. In order for the system processor 314 to identify the exact fault condition that has occurred, and where it has occurred, the system processor 314 may store fault data variables corresponding to each type of fault for each feed station 14, 16 or read-feed module 12. Thus, when the fault occurs, the system controller 312 sends all the relevant information about the fault to the system processor 314 which processes this information and changes the appropriate fault data variable accordingly. Each sensor function and/or action will be described in further detail below with respect to FIGS. 33 through 37.

FIG. 18 illustrates the functioning of the Infeed Mail Stack sensor 410 of an embodiment of the present invention. The Infeed Mail Stack sensor 410 may be, for example, an infrared reflective sensor such as Honeywell No. HPX-H2-H, and it is located above the upper infeed support paddle 70. When the infeed paddle drive motor 92 is in motion, the infeed paddles 70, 72 (upper and lower) are being raised up toward the Infeed Mail Stack sensor 410. The Infeed Mail Stack sensor 410 detects when the mail on the upper infeed support paddle 72 has reached the level of the sensor (i.e., the Infeed Mail Stack sensor 410 becomes blocked by the top of the mail stack). Upon detecting the mail stack, the sensor sends a signal to the local controller 304 through an input module 416. The local controller 304 may then process

this signal and instruct the infeed support paddle drive motor **92** to stop raising the infeed support paddles any further.

The Infeed Mail Stack sensor **410** may also indicate a fault condition. For example, when the infeed support paddle drive motor **92** is turned on, and the Infeed Mail Stack sensor **410** is not triggered (i.e., it does not become blocked) within a predetermined period of time, all or part of the machine is stopped, and the operator is alerted. In such a fault situation, the system controller **312** may shut down the entire machine or alternatively, it may shut down only the particular read-feed module **12** or individual feed station **14, 16** in which the fault is detected, so that the problem may be resolved. Upon detecting a fault condition, the system controller **312** may send a message to the system processor **314** indicating which module **14, 16** or feed station **12** caused the stoppage, so that the system processor **314** may notify the operator of the location of the fault.

FIG. **19** illustrates the functioning of the Picker Cylinder Extend and Retract sensors **430, 432**. These sensors may be, for example, Hall-effect sensors such as Bimba No. HSCQC-04, and are located near the bottom and top of the picker cylinder **434**, respectively. The Picker Cylinder Extend sensor **430** may be used to determine whether the picker **436** is fully extended. Similarly, the Picker Cylinder Retract sensor **432** may be used to determine whether the picker **436** is fully retracted. In a particular embodiment, it may be desirable to fully retract the cylinder **434** in order to get the picker out of the way of the camera when, for example, full image capture is desired.

When the picker **436** is fully extended, the Picker Cylinder Extend sensor **430** will normally send a signal to the system controller **312** via the corresponding local controller **304** indicating that the picker **436** is fully extended. The system controller **312** processes this "fully extended" signal, which indicates that the picker **436** is now in contact with the next piece of mail on the infeed stack, and the cycle may go on to the next step (i.e., the picker may pick up the piece of mail).

The Picker Cylinder Extend sensor **430** may also be used to indicate a fault situation. For example, when the picker cylinder does not lower completely and thus the Picker Cylinder Extend sensor **430** is not triggered within a predetermined amount of time, the system controller **312** never sends a "cycle complete" message to the system processor **314**. If the system processor **314** does not receive the "cycle complete" message, the system processor **314** may instruct the system controller **312** to shut down the entire machine or alternatively, it may shut down only the faulty feed station **14, 16** until the problem is resolved. In a preferred embodiment, the operator is alerted that a fault has occurred, as well as to the particular feed station **14, 16** in which the fault has occurred.

The Picker Cylinder Retract sensor **432** operates in a similar fashion, but senses when the picker cylinder **434** is fully retracted rather than fully extended. In addition, the Picker Cylinder Retract sensor **432** may also be used in a fault situation such as, for example, where the picker does not raise completely. In one embodiment of the present invention, the Picker Cylinder Retract sensor **432** may not be used at all.

FIG. **20** illustrates the functioning of the Gripper Cylinder Extend, Gripper Cylinder Retract, and Gripper Jaw Release sensors **442, 444, 446**, respectively.

A Gripper Jaw sensor **440** may be, for example, an infrared reflective sensor such as SUNX No. EX-14A-PN, and is located on the bottom portion of the gripper jaw **448**. The Gripper Jaw sensor **440** may be used to determine whether there has been a mail misfeed. A misfeed is sensed when the gripper jaw **448** fails to grip a piece of mail that was (or was supposed to be) picked up by the picker **436**. Under normal operating conditions, the Gripper Jaw sensor **440** senses a piece of mail between the gripperjaws **448**, and sends a "mail sensed" signal to the system controller **312** via the local controller **304**.

FIG. **9A** illustrates an alternate sensor **440***a* which can replace the gripper jaw sensor **440** and its function. Sensor **440***a* is mounted above the buffer platform, and cooperates with a reflector **440***b* on the buffer platform, such that when a mailpiece enters between the sensor **440***a* and the reflector **440***b*, the sensor trips, resulting in the "mail sensed" signal to be sent to the system controller.

In one embodiment of the present invention, there may be an index logic unit in the system controller **312** which counts the number of misfeeds in a given cycle, and when the number of misfeeds exceeds a predetermined maximum value, the system controller **312** shuts down the machine (or the particular feed station **14, 16**) and alerts the operator of the fault (including the station **14, 16** that caused the fault). In such an embodiment, the fault does not occur until after the number of misfeeds exceeds the predetermined maximum number.

The Gripper Jaw Release sensor **446** may be, for example, an infrared emitter/receiver sensor such as Honeywell No. HPJ-E21-008/HPJ-R22-001, and is located at the point along the gripper cylinder where the mail pieces are released (e.g., somewhere along the length of gripper cylinder). The Gripper Jaw Release sensor **446** is triggered when the gripper jaw is positioned below the Gripper Jaw Release sensor **446**. When the gripper jaw **448** is so positioned, the Gripper Jaw Release sensor **446** sends a signal to the local controller **304** via an input module **416** indicating that the gripper jaw **448** is in the "release" position. The local controller **304** then processes this signal and instructs the gripper jaw **448** to release the mail. The gripper jaw preferably includes a flexible, resilient high friction material on its edges to prevent slipping of the mailpieces.

The Gripper Cylinder Extend and Retract sensors **442, 444** may both be, for example, Hall-effect sensors such as Tolomatic No. SWBC406TU. These sensors function in an identical manner to the Picker Cylinder Extend and Retract Sensors **430, 432**. Thus, when either of these sensors senses the proper position of the gripper jaw **448** (e.g., when the Gripper Cylinder Retract sensor **444** senses that the gripper jaw **448** is in the home position, or when the Gripper Cylinder Extend sensor **442** senses that the gripper jaw **448** is in the grip position), a signal may be sent to the system controller **312** via the local controller **304** and processed by the system controller **312** to generate an appropriate instruction or message. That instruction is then sent to and carried out by the local controller **304**. Specifically, when either of these sensors is triggered, a signal is sent to the system controller **312** (via the local controller **304**) that the next step in the cycle may take place. For example, the triggering of the Gripper Cylinder Extend sensor **442** indicates that the most recent piece of mail picked up by the picker may be gripped by the gripper. Similarly, when the gripper jaw **448** is in the "home" position, the Gripper Cylinder Retract sensor **444** is triggered indicating that the next image capture may take place.

These Gripper Cylinder sensors **442, 444** may also be used to detect a fault condition. For example, when the gripper jaw **448** does not reach either the home or the grip

positions (detected by the Gripper Cylinder Retract and Extend Sensors, 444, 442, respectively), the "cycle complete" message is never sent to the system processor 314, the machine (or the particular feed station 14, 16) is stopped, and the operator is alerted.

FIG. 21 illustrates the functioning of the Buffer platform Cylinder Extend and Retract sensors 460, 462, respectively. These sensors 460, 462 may both be, for example, Hall-effect sensors such as Bimba No. HSCQC-04. These sensors function identical to the Picker Cylinder sensors 430, 432 and the Gripper Cylinder sensors 442, 444. Thus, when either of these sensors senses the proper position of the buffer platform (e.g., when the Buffer platform Cylinder Retract sensor 462 senses that the buffer platform is in the back position, or when the Buffer platform Cylinder Extend sensor 460 senses that the buffer tray is in the home position), a signal may be sent to the system controller 312 via the local controller 304 and processed by the system controller 312 to generate an appropriate instruction or message. That instruction is then sent to and carried out by the local controller 304. Specifically, when either of these sensors is triggered, a signal is sent to the system controller 312 (via the local controller 304) that the next step in the cycle may take place. For example, upon returning to the home position after being in the back position, the Buffer platform Cylinder Extend sensor 460 is triggered indicating that the next piece of mail may be picked up by the picker. Similarly, when the buffer tray is in the "back" position, the Buffer platform Cylinder Retract sensor 462 is triggered indicating that the buffer tray should be sent back to the home position.

These Buffer platform Cylinder sensors 460, 462 may also be used to detect a fault condition. For example, when the buffer platform does not reach the fully retracted (i.e., the back) position, the Buffer Cylinder Retract sensor 462 is not triggered, thus the "cycle complete" message is never sent to the system processor 314. The machine (or the particular feed station 14, 16) is stopped, and the operator is alerted. Similarly, when a buffer platform does not reach its "home" position and thus the Buffer Cylinder Extend sensor 460 is not triggered, the "cycle complete" message is never sent, so part or all of the machine is stopped. The operator is then notified of the particular feed station 14, 16 which caused the fault.

FIG. 22 illustrates the functioning of the Index (or Finger) sensor 470 and the Stack Height sensors 472 (one for each conveyer collation pocket 24). These sensors may all be, for example, infrared emitter/receiver sensors such as Honeywell No. HPJ-E21-008/HPJ-R22-001. The Index sensor 470 is located at the end of the collation conveyor belt 20, and detects when the collation conveyor belt 20 has completed one pocket advancement. Specifically, it detects when the next collation pocket finger 22 reaches the Index sensor 470. When the Index Sensor 470 detects that one pocket advancement is complete, a signal is sent to the local controller 304 via an input module 416, and the local controller 304 processes the signal and instructs the drive motor 478 to stop advancing the collation conveyer 18.

Similar to the other sensors discussed above, the Index sensor 470 may also be used to detect a fault condition. For example, if the next collation pocket finger 22 does not pass the Index sensor 470 after the conveyor drive motor 30 is turned on, the "cycle complete" message will not be sent to the system processor 314, the machine (or the particular feed station 14, 16) is stopped, and the operator is alerted.

The Stack Height sensors 472 are located near the top of the collation conveyer fingers 22 which separate the collation pockets 24. These sensors 472 detect when the stack of mail in a particular collation pocket 24 has reached a predetermined maximum height. When this predetermined maximum height is reached, a "full pocket" message is sent to the system controller 312 by the corresponding Stack Height sensor 472, and the system controller 312 sends that "full pocket" message to the system processor 314. The system processor 314 then uses the "full pocket" message to determine the "hold-accept-reject" message (explained above) associated with that collation pocket 24 so that any additional mail destined for the full pocket is rejected.

It should be understood that the embodiments herein described are merely illustrative of the principles of the present invention. Various modifications may be made by those skilled in the art without departing from the spirit or scope of the claims which follow. Other modifications or substitutions with equivalent elements are also contemplated.

What is claimed is:

1. An apparatus for depositing documents at a predetermined location on a moveable collation conveyor for distribution of said documents to a predetermined delivery point, each document imprinted with code designating a distinct delivery point, said documents delivered to said apparatus in a predetermined sequence, the apparatus comprising:

a) a moveable platform assembly adapted to support and advance a stack of said documents in said predetermined sequence towards a feed station;

b) a device disposed adjacent said feed station for electronically capturing an image of said delivery point code on each document as each document reaches said feed station;

c) a moveable buffer platform located adjacent said feed station;

d) a document unloading assembly adjacent said feed station and adapted to remove the topmost document from the stack of documents and place the topmost document on the moveable buffer platform;

e) a data processing unit adapted to transmit information received from said captured image of said delivery point code to an actuation and actuated device controlling movement of said buffer platform, said data processing unit determining the presence or absence of a match between said delivery point code on the document on said buffer platform and a delivery point designation corresponding to said predetermined location on said collation conveyor;

f) said moveable buffer platform moveable from a first position substantially above said collation conveyor to a second position substantially above a reject station, said data processing unit controlling movement of said moveable buffer platform between said first and second positions of said buffer platform; and

g) a document positioning device actuation and actuated in coordination with said moveable buffer platform and said data processing unit to deposit said document from said buffer platform to said collation conveyor in a first position of said document positioning device and said moveable buffer station, and to retain said document on said buffer platform in a second position of said document positioning device, when said buffer platform moves from said first position to said second position.

2. The apparatus of claim 1 wherein said data processing unit also determines at least one of (a) the presence or absence of a readable delivery point code on each document,

and whether each document is or is not in said predetermined sequence.

3. The apparatus of claim 1 wherein said reject station is disposed adjacent said collation conveyor, and said moveable buffer platform is disposed substantially above said reject station when said buffer platform is in said second position of said buffer platform.

4. The apparatus of claim 1 wherein said document positioning device deposits said document from said buffer platform to said reject station when said document positioning device is in said first position and said buffer platform moves from said second position to said first position.

5. The apparatus of claim 1 wherein said moveable platform assembly includes a first moveable platform slidably and pivotally mounted on said apparatus for sliding movement to a plurality of substantially vertical positions adjacent said feed station, and for pivotal movement in a substantially horizontal direction at each of said vertical positions, said first moveable platform adapted to support a first stack of documents and advance said stack of documents to said feed station as said moveable first platform moves in a first vertical direction toward said feed station.

6. The apparatus of claim 5 wherein said moveable platform assembly includes a second moveable platform slidably and pivotally mounted on said apparatus for movement to a plurality of substantially vertical positions adjacent said feed station, and for pivotal movement in a substantially horizontal direction at each of said vertical positions, said second moveable platform adapted to support a second stack of said documents adjacent said first stack of documents.

7. The apparatus of claim 6 wherein each of said first and second moveable platforms is adapted to be pivotally removed from between and inserted between said first and second stacks of documents.

8. The apparatus of claim 6 wherein one of said moveable platforms is disposed between said first and second stack of documents, and the other of said moveable documents supports said second stack of documents adjacent said first stack of documents, said one moveable platform adapted for pivotal movement away from between said stacks of documents, wherein said other moveable platform supports both stacks of documents and said one moveable platform is moved to a position beneath said first and second stacks of documents, said one moveable platform adapted to support a third stack of documents adjacent said second stack of documents.

9. The apparatus of claim 5 wherein said first platform is slidably and rotatably mounted on a stationary shaft forming part of the apparatus, drive means adapted to engage said first platform to drive said first platform substantially vertically upward and to prevent said first platform from moving substantially vertically downward when said first platform is in engagement with said drive means, and to allow substantially vertical downward movement of said first platform when said first platform is moved out of engagement with said drive means.

10. The apparatus of claim 6 wherein said first and second platforms are slidably and rotatably mounted on respective stationary shafts forming part of the apparatus, first and second drive means adapted to engage said first and second platforms, respectively, and to drive said first and second platforms independently in a substantially upward direction and to prevent either of said first or second platforms from moving substantially vertically downward when said first and second platforms are in engagement with said drive means, each of said platforms rotatable out of engagement with said drive means to allow movement of said first and second platforms in a substantially vertical downward direction.

11. The apparatus of claim 1 wherein the device for capturing the image of the delivery point code is disposed above the feed station and is adjustable to capture an image of a delivery point code at any location on the topmost document of said stack of documents on said platform assembly.

12. The apparatus of claim 1 wherein the device for capturing the image of the delivery point code is a closed couple device camera that creates a digital image of the delivery point code on the topmost document in said stack, and transmits said digital image to said data processing unit.

13. The apparatus of claim 1 wherein said document unloading assembly includes a first document engaging device adapted to move from a first position where the first document engaging device engages the leading edge of the topmost document of the stack of documents to a second position where the first document engagement device, while engaging the leading edge of the topmost document, lifts the leading edge of the topmost document from the stack of documents.

14. The apparatus of claim 13 wherein said first document engaging device is mounted on a support plate, said support plate being pivotally mounted to move between a first lateral extended position and a second lateral retracted position on said apparatus adjacent said feeding station; said support plate moveable from said first lateral extended position to said second lateral retracted position after said image capture device has captured the delivery point code on the topmost of said documents in said stack.

15. The apparatus of claim 13 wherein said document unloading assembly includes a second document engaging device adapted in a first position to engage the leading edge of the document when the leading edge of the document is lifted, said second document engaging device moveable in a substantially horizontal direction to a second position where the engaged document is released and deposited on said buffer platform disposed substantially above said collation conveyor.

16. The apparatus of claim 15 wherein said second document engaging device comprises a stationary jaw member adapted to engage the underside of the lifted leading edge of said topmost document, and a moveable clamping member adapted to forcefully engage the topside of the topmost document and firmly hold the document between the stationary jaw member and the moveable clamping member as said second document engaging device moves said topmost document from said stack to said buffer platform.

17. The apparatus of claim 16 wherein said second document engaging device moves in a linear direction wherein said topmost document is moved from said stack to said buffer platform.

18. The apparatus of claim 14 wherein said first document engaging device includes a plurality of vacuum gripping devices operatively connected to a vacuum source, said plurality of vacuum gripping devices mounted on a mounting plate slidably attached to said support plate for vertical movement of said plurality of vacuum gripping devices relative to said support plate.

19. The apparatus of claim 18 including an actuating mechanism operatively connected to the data processing unit and to said slidable mounting plate to control the movement of said slidable mounting plate and said plurality of vacuum gripping devices.

20. The apparatus of claim 15 wherein the document positioning device includes a retractable stopping element adapted to move from a document engaging position to a retracted position, said retractable stopping element when in said document engaging position engaging said topmost document and retaining said topmost document on said buffer platform as said second document engaging device moves beyond said second position of said document engaging device, said second document engaging device releasing said topmost document onto said buffer platform when said second document engaging device moves beyond said second position of said document engaging device.

21. The apparatus of claim 20 wherein an upper surface of said buffer platform includes at least one groove extending in the direction of movement of said buffer platform; said retractable stopping element having at least one finger extending into said at least one groove when said retractable stopping element is in said document engaging position and said buffer platform is located substantially over said collation conveyor, said topmost document abutting said at least one finger and coming to rest on said buffer platform.

22. The apparatus of claim 21 including control means to move said buffer platform from said first position to said second position; said at least one finger of said retractable stopping element sliding in said at least one groove as said buffer platform moves to said second position and said retractable stopping element is in said document engaging position; said at least one finger abutting said topmost document and retaining the position of said topmost document as said buffer platform slides out from under the topmost document, said topmost document being deposited onto said collation conveyor when said buffer platform reaches said second position.

23. The apparatus of claim 21 including control means to move said buffer platform from said first position to said second position and back to said first position;

means to move said retractable stopping element to a retracted position, removing said at least one finger from said at least one groove;

said buffer platform moved from said first position to said second position by said control means with said retractable stopping element in said retracted position and said document remaining on said buffer platform;

said retractable stopping element moved to said document engaging position when said buffer platform is in said second position;

said document held in position by said retractable stopping element as said buffer platform moves from said second position back to said first position and out from under said document;

said document being deposited upon said reject station when said buffer platform returns to said first position.

24. The apparatus of claim 22 wherein said control means is operatively connected to said data processing unit, said data processing unit generating a first signal indicating the presence of a match between said delivery point code on said document disposed on said buffer platform and a delivery point designation corresponding to said predetermined location on said collation conveyor, and said predetermined location on said collation conveyor is substantially beneath said buffer platform.

25. The apparatus of claim 22 wherein said data processing unit generates a signal indicating the absence of a match between said delivery point code on said document disposed on said buffer platform and a delivery point designation corresponding to the predetermined location on the collation conveyor substantially beneath said buffer platform, and said buffer platform remains in said first position supporting said document until said data processing unit detects said match.

26. The apparatus of claim 21 wherein said control means is adapted to move said buffer platform from said first position to said second position and back to said first position;

a buffer control signal generated by said data processing unit, said buffer control signal transmitted to said means for moving said buffer platform and said retractable stopping element to move said retractable stopping element to its retracted position, removing said at least one finger from said at least one groove;

said buffer control signal also initiating movement of said buffer platform from said first position to said second position of said buffer platform, said topmost document remaining supported by said buffer platform as said buffer platform moves to said second position;

said retractable stopping element moving to said document engaging position when said buffer platform is in said second position, said at least one finger engaging a trailing edge of said document and holding said document in a stationary position as said buffer platform moves from said second position to said first position and moves out from under said document;

said document being deposited on said reject conveyor when said buffer platform reaches said first position of said buffer platform.

27. The apparatus of claim 23 wherein said control means receives a second signal from said data processing unit indicating one of an unreadable delivery point code on said topmost document and a delivery point code which is in improper sequence, said control means, upon receipt of said second signal actuating said apparatus to:

(a) move said retractable stopping element to a retracted position;

(b) move said buffer platform from said first position to said second position;

(c) move said retractable stopping element to said document engaging position; and

(d) moving said buffer platform from said second position to said first position, said buffer platform moving out from under said document.

28. An apparatus for collating documents disposed in a plurality of stacks, each stack including similar documents, each document in a stack imprinted with different address code designating a distinct delivery point, the documents in each stack being arranged in a predetermined sequence, said apparatus for collating documents comprising:

a plurality of document collating stations;

a movable collation conveyor extending along said plurality of collation stations, said collation conveyor including a plurality of pockets, each pocket designated by a distinct delivery point address;

each said collation station including:

a) an advancing device adapted to advance a stack of documents towards a feeding station;

b) the feeding station including an image capture device to capture the image of the delivery point code on each document in the stack of documents as each document reaches the top of its respective stack, each said image being electronically stored in a data processing unit;

c) a movable buffer platform, movable from a first position adjacent said feeding station and above said

collation conveyor to a second position over a document reject station, movement of said buffer platform under the control of said data processing unit;

d) a document unloading assembly engaging the topmost document in the stack of documents, and position said topmost document on said moveable buffer platform;

e) a document positioning device moveable between a first position and a second position, to correct the antecedent basis problem document engaging element adapted to engage the document on said buffer platform in said first position of said document engaging element and to deposit said document onto a pocket on said collation conveyor as said buffer platform moves from said first position to said second position of said buffer platform, said pocket having a distinct delivery point designation corresponding to the district delivery point code on said topmost document.

29. The apparatus of claim 28 wherein the document positioning device is further adapted to move to said second position and retain said document on said buffer platform when said buffer platform moves to the second position of said buffer platform; said document being placed over a reject station when said buffer station is in said second position of said buffer platform.

30. The apparatus of claim 29 wherein said document positioning device is adapted to move to said first position and engage said document on said buffer platform when said buffer platform is in said second position, and to deposit said document from said buffer platform to said reject conveyor when said buffer platform is moved to said first platform.

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(54) DELIVERY POINT MERGE AND PACKAGING DEVICE AND METHOD OF USE

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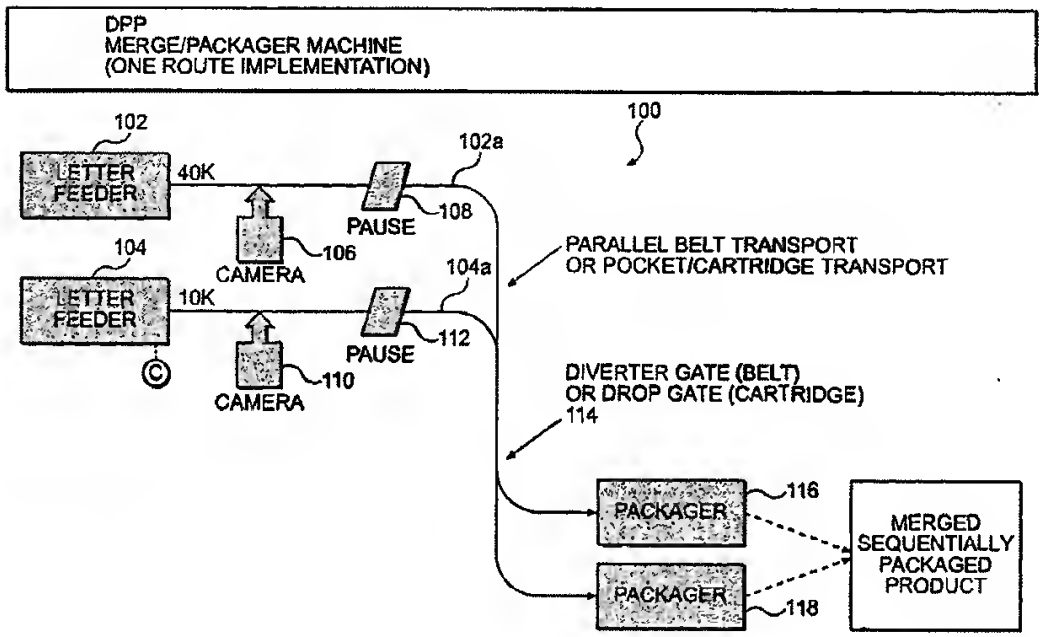
(57) ABSTRACT

A device and method for merging pre-sequenced products includes at least a first and a second feeder mechanism. The first feeder mechanism feeds a stream of first pre-sequenced product and the second feeder mechanism feeds a stream of second pre-sequenced product. A reading device reads product information of each product of the stream of the first and second pre-sequenced product. A pausing device pauses one of the first stream of pre-sequenced product and the second stream of pre-sequenced product based on the information read from the reading device. The product from one or both of the stream of first and second pre-sequenced product having the same product information is organized into a sequentially merged order.



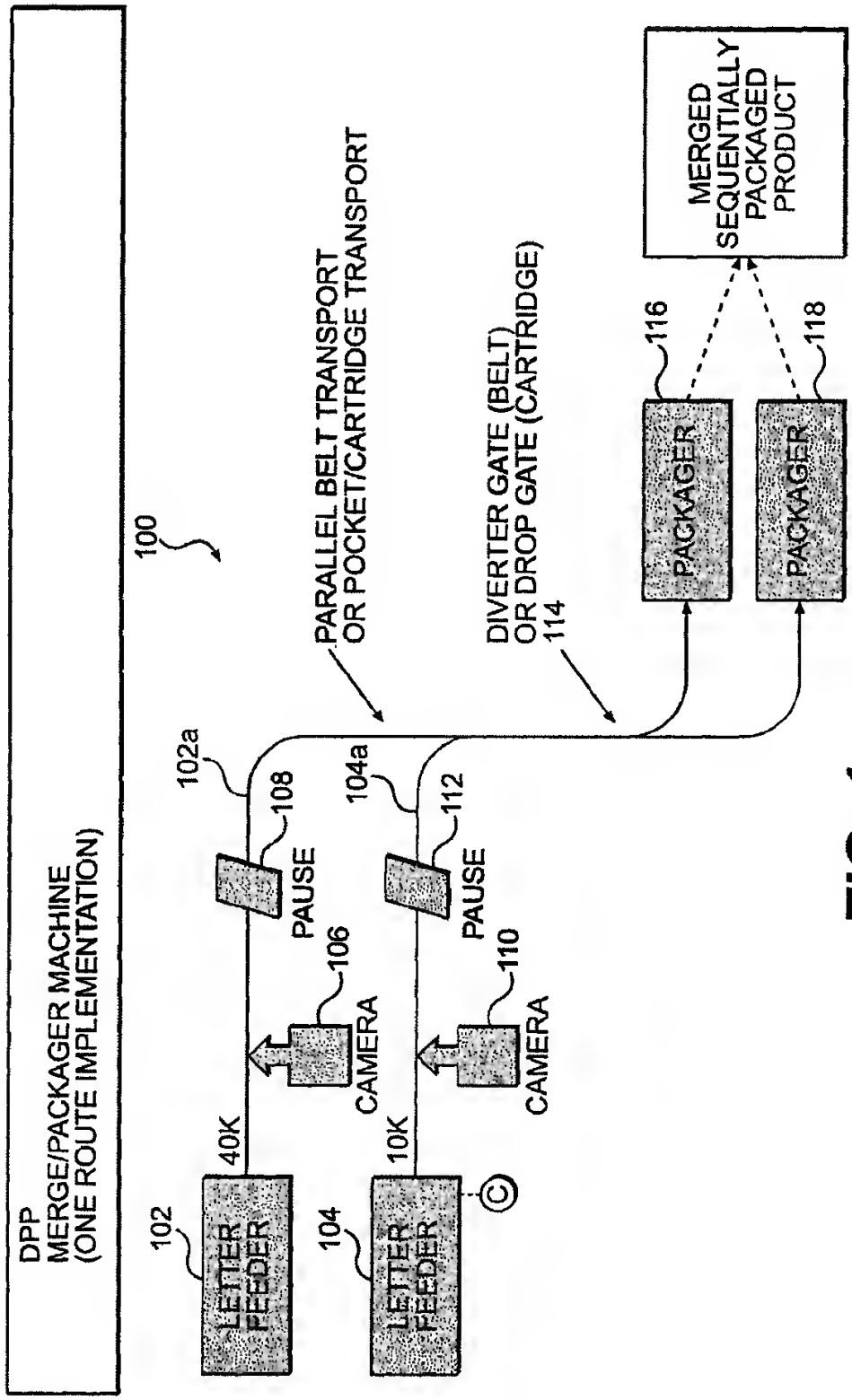

DPP
MERGE/PACKAGER MACHINE
(ONE ROUTE IMPLEMENTATION)
100
PARALLEL BELT TRANSPORT
OR POCKET/CARTRIDGE TRANSPORT
DIVERTER GATE (BELT)
OR DROP GATE (CARTRIDGE)
114
MERGED
SEQUENTIALLY
PACKAGED
PRODUCT
PACKAGER
116
PACKAGER
118
102a
104a
108
PAUSE
112
PAUSE
106
CAMERA
110
CAMERA
40K
10K
102
LETTER
FEEDER
104
LETTER
FEEDER

FIG. 1

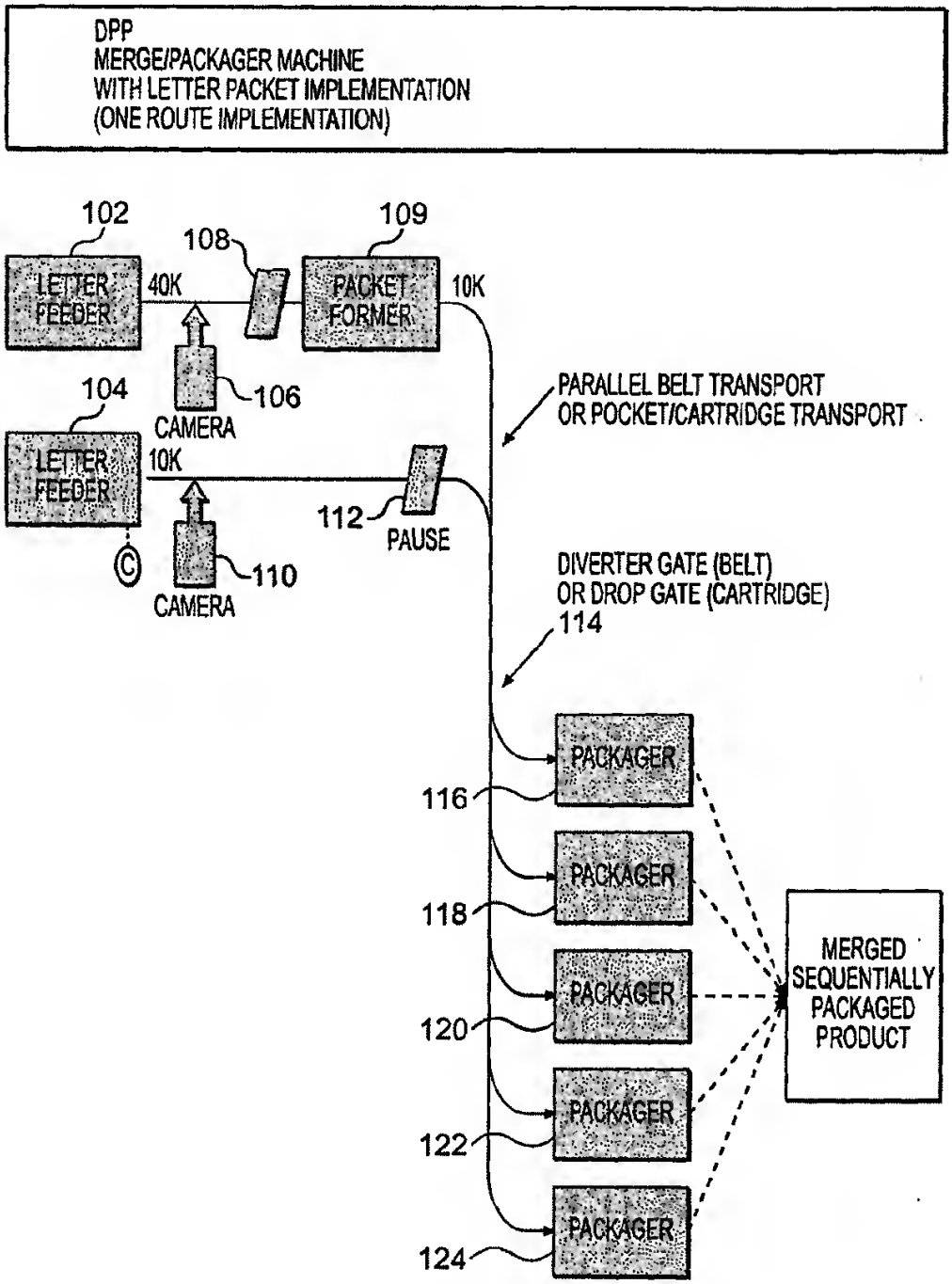

DPP
MERGE/PACKAGER MACHINE
WITH LETTER PACKET IMPLEMENTATION
(ONE ROUTE IMPLEMENTATION)
102
LETTER FEEDER
40K
108
109
PACKET FORMER
10K
104
LETTER FEEDER
10K
106
CAMERA
112
PAUSE
110
CAMERA
PARALLEL BELT TRANSPORT
OR POCKET/CARTRIDGE TRANSPORT
DIVERTER GATE (BELT)
OR DROP GATE (CARTRIDGE)
114
PACKAGER
PACKAGER
PACKAGER
PACKAGER
PACKAGER
116
118
120
122
124
MERGED SEQUENTIALLY PACKAGED PRODUCT

FIG. 2

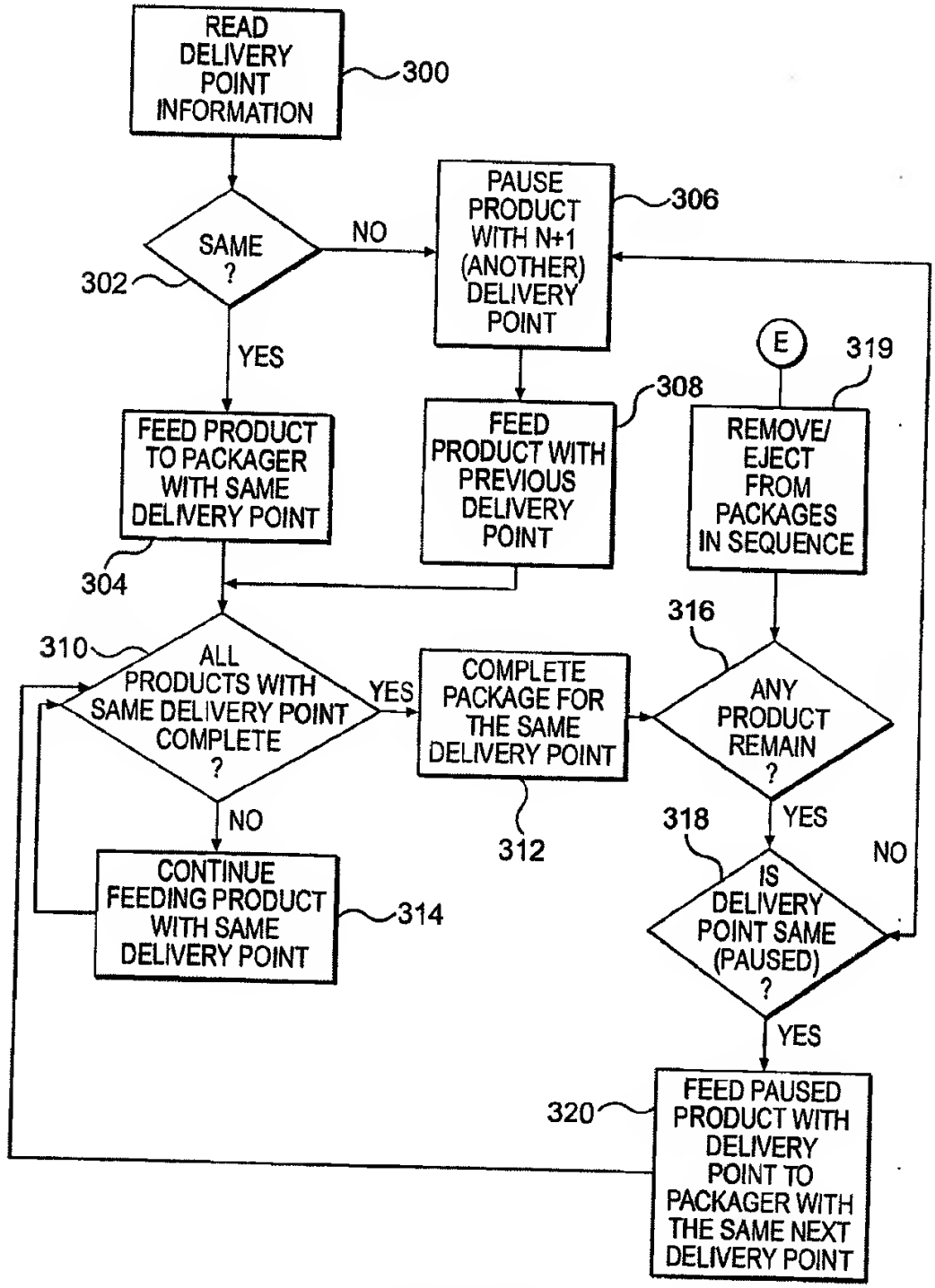

READ DELIVERY POINT INFORMATION
300
SAME ?
302
NO
PAUSE PRODUCT WITH N+1 (ANOTHER) DELIVERY POINT
306
YES
FEED PRODUCT TO PACKAGER WITH SAME DELIVERY POINT
304
FEED PRODUCT WITH PREVIOUS DELIVERY POINT
308
E
319
REMOVE/ EJECT FROM PACKAGES IN SEQUENCE
310
ALL PRODUCTS WITH SAME DELIVERY POINT COMPLETE ?
YES
NO
COMPLETE PACKAGE FOR THE SAME DELIVERY POINT
312
316
ANY PRODUCT REMAIN ?
YES
NO
318
IS DELIVERY POINT SAME (PAUSED) ?
YES
NO
CONTINUE FEEDING PRODUCT WITH SAME DELIVERY POINT
314
320
FEED PAUSED PRODUCT WITH DELIVERY POINT TO PACKAGER WITH THE SAME NEXT DELIVERY POINT

FIG. 3

DELIVERY POINT MERGE AND PACKAGING DEVICE AND METHOD OF USE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to a merging device and, more particularly, to a delivery point merge and packaging device for merging separate streams of pre-sequenced products and a method of use.

[0003] 2. Background Description

[0004] The sorting of mail is a very complex, time consuming task. In general, the sorting of mail is processed though many stages, including back end processes, which sort or sequence the mail in delivery order sequence. These processes can either be manual or automated, depending on the mail sorting facility, the type of mail to be sorted such as packages, flats, letter and the like. A host of other factors may also contribute to the automation of the mail sorting, from budgetary concerns to modernization initiatives to access to appropriate technologies to a host of other factors.

[0005] In general, however, most modern facilities have taken major steps toward automation by the implementation of a number of technologies. These technologies include, amongst others, letter sorters, parcel sorters, advanced tray conveyors, flat sorters and the like. As a result of these developments, postal facilities have become quite automated over the years, considerably reducing overhead costs.

[0006] But, in implementation, problems still exist. For example, currently, it is known to sequence letters using a mail sorter based on, for example, a two pass algorithm. Of course, other known systems can equally be used to sort letters, a host of them readily available and known to those of ordinary skill in the art. On the other hand, sequencing flats is typically performed manually using "cases". That is, flats are typically manually sequenced using cases having several hundred bins or shoots that are representative of delivery points for a route of a mail carrier. This can include, for example, 650 different delivery points. This process is very time consuming and labor intensive. For example, a person must manually read the address or delivery point for each flat and place it in the appropriate bin.

[0007] Now, to merge the pre-sequenced letters with the pre-sequenced flats can be troublesome and is usually performed using the same case for the flats in a manual process. In toto, the entire process can include three or more separate and distinct processes to merge the flats with the letters or other types of products. First, the letters are pre-sequenced using any well known method, such as the two pass algorithm. The flats are sequenced using the known manual processes. Once the flats are sequenced, the pre-sequenced letters are then manually placed within each of the respective shoots of the case, associated with the delivery point of the flat. After the letters and flats are sorted together in the case, the merged mail product is removed from the case while maintaining delivery sequence so that the merged mail products can then be further processed for delivery. This is a very time consuming, labor intensive and expensive procedure.

[0008] The present invention is directed to overcoming one or more of the problems as set forth above.

SUMMARY OF THE INVENTION

[0009] In a first aspect of the invention, a device for merging pre-sequenced products includes at least a first and a second feeder mechanism. The first feeder mechanism feeds a stream of first pre-sequenced product and the second feeder mechanism feeds a stream of second pre-sequenced product. A reading device reads product information of each product of the stream of the first and second pre-sequenced product. A pausing device pauses the first stream of pre-sequenced product or the second stream of pre-sequenced product based on the information read from the reading device. The product from one or both of the stream of first and second pre-sequenced product having the same product information is organized into a sequentially merged order.

[0010] In another aspect of the present invention, a method for merging in a sequential order a first type of product and a second type of product is provided. The steps include reading product information from a first stream of pre-sequenced products of the first type of product and reading product information from a second stream of pre-sequenced products of the second type of product. The first and second types of product of the first and second stream of pre-sequenced products having same product information are merged in sequential order.

[0011] In another aspect of the present invention, a method is provided for merging in a sequential order disparate product types. The method includes reading product information from a first and second stream of pre-sequenced products of a first and second type of product. The first and second type of product of the first and second stream of pre-sequenced product having same product information are merged into a sequential stream as determined in the reading steps. The merged sequential stream of the first and second type of product is provided to separate destinations based on delivery point segments for parallel processing such that packages are formed of the first and second type of product having the same product information. The packages are removed in delivery point sequence.

[0012] In yet another aspect of the present invention, a machine readable medium containing code for merging in a sequential order a first type of product and a second type of product is provided. The machine readable medium containing code includes a module for reading product information from a first stream of pre-sequenced products of the first type of product and a module for reading product information from a second stream of pre-sequenced products of the second type of product. This aspect further includes a module for merging in sequential order the first and second type of product of the first and second stream of pre-sequenced product having same product information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

[0014] FIG. 1 shows a general schematic diagram of the merging device of the present invention;

[0015] FIG. 2 shows another embodiment of the merging device of the present invention; and

[0016] FIG. 3 is a flow diagram showing steps implementing the method of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0017] The present invention is directed to a merging device and more particular to a device capable of merging pre-sequenced products such as, for example, flats and other mail items (i.e., letters), into a merged, sequenced stream for future delivery or warehousing or the like. In aspects of the present invention, the products may be packaged into separate deliverable packages at a downstream point, after the sequenced merge of such products. In other aspects of the present invention, the merging device is capable of providing separate streams of pre-sequenced letters and flats into sequenced streams ready for delivery by a mail carrier for a specific mail carrier route. The system and method of the present invention significantly reduces processing times for sequencing both flats and mail pieces or other disparate products in delivery point sequence using, in embodiments, parallel processing. Other applications such as warehousing and storage applications are also contemplated for use with the present invention.

Merging System of the Present Invention

[0018] Referring now to FIG. 1, a general schematic diagram of the merging device of the present invention is shown. In the embodiment of FIG. 1, the merging device is generally depicted as reference numeral **100** and includes a first feeder **102** and a second feeder **104**. In embodiments, the first feeder **102** is a letter feeder with a feed rate capacity of approximately 40,000 letters per hour and the second feeder **104** is a flat feeder with a feed rate capacity of approximately 10,000 flats per hour. Those of ordinary skill in the art should recognize, though, that other types of feeders, feeding capacity rates and the like may also be used with the present invention, and that the feeders **102** and **104** shown in FIG. 1 are provided for illustrative purposes in describing the present invention. It should further be recognized that more than two feeders are also contemplated for use with the present invention.

[0019] Referring still to FIG. 1, two conveying tracks **102***a* and **104***a* are associated with each of the feeders **102** and **104**, respectively. These conveying tracks may be parallel belt transports, pocket/cartridge transports or any other well known conveying or transporting system for transporting mail pieces, flats and the like (hereinafter referred generally as product), as described below. A camera, optical reading device or other type of reading device **106** and a pause device **108** are provided downstream of the feeder **102**. Similarly, a camera, optical reading device or other type of reading device **110** and a pause device **112** are provided downstream of the feeder **104**. In systems with more than two feeders, a configuration is contemplated with a respective number of reading devices and pause devices. A control "C" controlling the device of the present invention is also provided.

[0020] In embodiments, the cameras or other reading type devices **106** and **110** may be mounted to the respective conveying tracks **102***a* and **104***a*, but may be located near or proximate to the conveying tracks **102***a* and **104***a*. The cameras or reading devices **106** and **110** are designed to read the delivery point or other pertinent product information provided on each product. In aspects of the present invention, the products and hence the product information is provided in a pre-sequenced order from either highest order to lowest order or vice versa. The pause devices **108** and **112** may, similarly, be built into or located proximate to each of the respective conveying tracks to allow each type of product to be paused or stopped, at appropriate times, in the stream. The pause devices **108** and **112** may be located at a distance from the reading devices so that the bar code or other information can be interpreted before the product reaches the respective pause device **110** and **112**. This allows the pause devices to pause or stop the product based upon the information associated with the bar code or other information such as area code and the like (i.e., delivery point address) of each individual product. It is at this pausing step, that products with the same information begin to be organized into a merged sequentially ordered package with the same information. One or more packagers **116** and **118** may be located downstream from the pause devices **108** and **112**.

[0021] In embodiments, the conveying track **102***a* may be a parallel belt implementation which carries the product between two tightly adjacent parallel belts from device to device, allowing only minimal slip of the product versus belt movement. Diverters **114** may be placed between sections of the parallel belts for directing the products to the respective packager **116** and **118** or destination bin based on the product information such as delivery point. In another implementation, a flat cartridge implementation may be used which includes a transport comprising cartridges that move in a circulating manner from the feeders **102** and **104** to all destinations and then back to the feeders **102** and **104**. The cartridges may each contain a number of pockets into which product are placed from the feeders, one product per pocket. At the packager destination, a door on the pocket may open, to allow the product to be ejected into a destination bin or packager.

[0022] The packager packages the products such as letters and flats, for each delivery destination. The packaging may either be a physical or defacto package. In an embodiment, the packagers **116** and **118** package the product in delivery point sequence, in an attached stream of packets, enabling the mail carrier to simply detach each sequential packet at each sequential destination. With the packages in guaranteed sequence, the effort required by the carrier at each delivery point is considerably reduced. The packagers **116** and **118** may perform the packaging of the product in parallel, as discussed below.

[0023] FIG. 2 shows another embodiment of the present invention. In this embodiment, a packet former **109** is located downstream from the feeder **102**, as well as downstream from the reading device **106** and the pause device **108**. In embodiments, the packet former **109**, working in conjunction with the pause device **108**, collects all letter mail pieces (or other product) having a same destination information (delivery point) or same product information into a packet, up to a maximum total packet thickness. The maximum packet thickness may be based on the maximum thickness that can be transported between the belts and properly diverted or transported in one cartridge pocket. The packet is then transported to its destination and ejected as a single piece into the destination bin or packager. In this embodiment, five (5) packagers are provided **116**, **118**, **120**,

122 and 124, but more or less than this number of packagers can also be provided depending on the particular application of the present invention. This implementation provides a significant total realized throughput increase.

Method of Merging Product Using the System of the Present Invention

[0024] The system of the present invention may be used for a single carrier route at a time, multiple routes at once or for warehousing or other sequencing needs of disparate pre-sequenced products. For illustrative purposes and not to limit the present invention in any manner, a single route sequencing with letter packet implementation will be described as an illustrative example. For a single route, the optimum number of packagers to be operated in parallel can be derived based on the following assumptions for this illustrative example:

[0025] 1. An average route of 650 stops (delivery points) with 4000 letters and 1000 flats.

[0026] 2. Four (4) letters are packaged in each packet. This translates into processing letters for 10,000 packets per hour with a letter feeder running at 40,000 letters per hour. The time duration for processing 4000 letters into 1000 packets is 1/10 hour=6 minutes.

[0027] 3. The flat feeder runs at 10,000 pieces per hour. The time duration for processing 1000 flats is 1/10 hour=6 minutes.

[0028] Using these examples as an illustration, the sort of an entire route or other purpose takes approximately 12 minutes or less. (If flats and letter packets alternate, the system of the present invention can be adjusted to sort at a significantly higher rate.) Those of ordinary skill in the art may also implement these calculations for other applications.

[0029] Given then that the illustrative route takes approximately 12 minutes to sort, it would be ideal to have enough parallel operating packagers to package at the rate of sortation. Now, assuming that a packager can complete a package cycle every 5 seconds, 12 packages can be formed in a minute. During a 12 minute period, 144 packages can be produced. For a route having 650 delivery points, thus requiring 650 packages, the need is then for five packagers, as shown in FIG. 2. But, other number of packagers can also be used, depending on the specific application. For example, four packagers could service a route having 144×4=576 delivery points.

[0030] In this illustrative example, using the five packagers translates into 130 (650/5) delivery point groups. Thus, each packager will then produce 130 delivery point sequenced packages, either physical or defacto packages. The sequenced streams of letters and flats (or other types of products) that are input are set up to take advantage of the five packagers. With the illustrative route divided into five segments, each segment will have a delivery point designation as #1, #2, . . . #130. To keep all packagers running at maximum throughput, products for delivery point #1 will be sent to all packagers, followed by mail for delivery point #2 being sent to all packagers and the like. For example, products for delivery point #1 will be provided to packagers 1, 2, 3, 4 and 5. And, if further products remain, the products will be again sent to packagers 1, 2, 3, 4 and 5, or as many required packagers needed for the corresponding number of products to be packaged. This same example may be used for all delivery points. In this way, the packagers are designed to run in parallel.

[0031] The lowest sequence number occurring in the products such as flats or letter stream should be processed onto the transport first (or vice versa). In the example using letters and flats, if the sequence numbers are the same, the letters should be processed first. However, in other illustrations, the flats may be processed first. If a delivery point for one of the segments is missed, the next delivery point for that sequence should not be advanced into the missed position, i.e., all delivery point #n product should be processed in the serial input stream before delivery point #n+1 product is encountered.

[0032] With five packagers, the mail sequence scheme for a 650 delivery point route will be as follows. It should be understood that that one or more product will be together for each delivery point shown and blanks are representative of no product to be delivered to that delivery point.

1	131	261	391	521
2	132	262	392	522
3		263	393	523
4	134	264		524
	135	265	395	525
6	136	266	396	526

[0033] The following tables show as an example of the combined product, i.e., letters (L) and flats (F), mail streams as they are processed on the transport (Table 1) and provided to the packager of destination bin (Table 2) using the implementation of the present invention.

TABLE 1

Product Stream on Transport									
L1	F1	L131	L261	F261	L391	F391	L521	F521	
L2	F2	L132	L262	F262	L392	F392	L522	F522	
L3	F3	F133	L263	F263	L393	L523	F523		
L4	L134	F134	L264	F264	F394	L524			
F5	L135	F135	L265	L395	F395	L525	F525		
L6	F6	L136	F136	L266	F266	L396	F396	L526	F526

[0034]

TABLE 2

Sequentially Merged Product Stream						
Packager 1	(L1, F1)	(L2, F2)	(L3, F3)	(L4)	(F5)	(L6, F6)
Packager 2	(L131)	(L132)	(F133)	(L134, F134)	(L135, F135)	(L136, F136)
Packager 3:	(L261, F261)	(L262, F262)	(L263, F263)	(L264, F264)	(L265)	(L266, F266)
Packager 4	(L391, F391)	(L392, F392)	(L393)	(F394)	(L395, F395)	(L396, F396)
Packager 5	(L521, F521)	(L522, F522)	(L523, F523)	(L524)	(L525, F525)	(L526, F526)

[0035] The letter and flats will be removed or ejected from the packagers in delivery point sequence. That is, packager

1 will have delivery points for 1-130, for example, packager 2 will have delivery points for 131-260 and so on.

[0036] FIG. 3 is a flow diagram showing the steps of implementing the method of the present invention. The steps of the present invention may be implemented on computer program code in combination with the appropriate hardware. This computer program code may be stored on storage media such as a diskette, hard disk, CD-ROM, DVD-ROM or tape, as well as a memory storage device or collection of memory storage devices such as read-only memory (ROM) or random access memory (RAM). FIG. 3 may equally represent a high level block diagram of the system of the present invention, implementing the steps thereof.

[0037] In particular, in step 300, the reading devices read the destination or delivery point information or other product information (generally referred to hereinafter as delivery point information for purposes of this discussion) of the products as they are ejected from each of the feeders. In the example provided herein, a letter feeder and a flat feeder are provided as an illustrative example of the present invention; however, as previously discussed, the present invention may use more than two feeders, and other types of products may be used with such feeders. Thus, the present invention should not be limited to the use of only flats and letters, but may be used with other products such as packages and the like. It should also be recognized now that delivery point information may include any indicia, key, code (i.e., 11 digit post code) or the like for showing an association between the products such as for warehousing, storing or the like.

[0038] In step 302, a determination is made as to whether the products from both feeders include the same delivery point information. If the determination is affirmative, in step 304, the products (i.e., letters and flats) are processed through to the packagers or destination bins in a merged sequential order based on the original sequence of the products. Using the embodiment of FIG. 2, all letters or first type of product with the same delivery point information are provided in a single packet while the flats or other type of products are paused. Once the first type of product is formed into an appropriate sized packet or packets, the method of the present invention will continue with step 304. Those of ordinary skill should appreciate that all product with a different product information will be paused until the packet having product with previous delivery point information is ejected from the packet former. This entire process may assist in advancing the system when the feeder for the first type of product has a feed rate capacity greater than that of the feeder of the second type of product.

[0039] In one embodiment, in step 304, all letter(s) having the same delivery point information may be processed through to the packagers or bins, while the flat(s) for the same delivery point are paused by the pause device. Once the letter(s) are processed, the flat(s) are then processed and emptied into the bin. Of course, the present invention may process the flat(s) through the system first and then the letter(s), or both may be processed substantially simultaneously. The packagers may package the products into a single, physical package for a single delivery point.

[0040] In one aspect of the present invention, though, the products from the first and the second feeder with the same delivery point information may be formed into a "defacto" package. In this illustration, the first type of product such as letters for all of the same delivery point may be processed through to the packagers or bins. Next, all of the second type of products such as flats with the same delivery points as the previously processed letters are processed through to the packagers or bins. In this manner, the letter(s) for the first delivery point are separated from the letter(s) for another delivery point by the flat(s) having the first delivery point. A carrier can thus easily determine separate products for a single delivery point by determining the separation point between the letters and the flats, i.e., a defacto package.

[0041] If the products from the first and second feeders do not have the same delivery point information, in step 306, the product with a subsequent or different delivery point n+1 is paused (i.e., stopped) by the method of the present invention. Then, in step 308, the same type of product or products with the previous delivery point from the same feeder is processed through to the packagers or bins. It should be understood that step 304 may be eliminated in the rare instance that no products have the same delivery point.

[0042] In step 310, a determination is made as to whether all products with the same delivery point have been processed by the present invention. If yes, then, in step 312, the package of products for that delivery point is completed. The package may be either a defacto package or a physical package. If products remain with the same delivery point, then, in step 314, the transport will continue feeding the product with the same delivery point in order to provide the products in a merged sequential order to the packagers or bins. Steps 310 and 314 will repeat until a determination is made that no products remain with the same delivery point.

[0043] In step 316, a determination is made as to whether there are any products remaining. If no products remain, then in step 319, the packaged products (i.e., defacto or physical) are removed or ejected from the packagers in a merged sequential delivery point order. That is, packager 1 will eject into one or more bins (or other type of containers) its respective set of delivery points, for example, delivery points 1-130, depending on the amount of mail pieces for that set of delivery points. Similarly, packager 2 will eject into one or more bins its respective set of delivery points, for example, delivery points 131-260, depending on the amount of mail pieces for that set of delivery points, and so on. Now the bins are ejected in sequence.

[0044] The method of the present invention then ends at "E". If there are further products, a determination is then made, in step 318, as to whether a delivery point of the paused product is the same as products exiting from the other feeder. If so, the paused product, in step 306 and the remaining products with the same delivery point are processed through to the packager or bin. If there are no products from the other feeder with the same delivery point, then only the paused product (and other products from the same feeder) for that delivery point will be processed (i.e., provided in a sequential order). If there is a product with a subsequent or different delivery point n+1 from the other feeder, that product will again be paused, in step 306, and the method of the present invention will continue through at step 308. Steps 310-320 may be repeated until no further products remain and the method of the present invention ends at "E".

[0045] In embodiments of the present invention, the packagers will package the products having the same delivery

point for each of their route segments in parallel, as discussed above. In this manner, the steps implemented in the flow chart of FIG. 3 may not necessarily be limited to the specific order shown. For example, steps 312 may be implemented prior to, during or after steps 316, 318 and 320. Similarly, step 314 may be performed prior to, during or after step 312, by way of example.

[0046] While the invention has been described in terms of preferred embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A device for merging pre-sequenced products, comprising:

at least a first feeder mechanism feeding a stream of first pre-sequenced product;

at least a second feeder mechanism feeding a stream of second pre-sequenced product;

a reading device reading product information of each product of the stream of the first and second pre-sequenced product; and

a pausing device pausing one of the first stream of pre-sequenced product and the second stream of pre-sequenced product based on the information read from the reading device such that product from one or both of the stream of first and second pre-sequenced product having same product information determined in the reading step is organized into a sequentially merged order.

2. The device of claim 1, further comprising a transport system for transporting the stream of first and the second pre-sequenced product past the reading device and the pausing device to a downstream destination.

3. The device of claim 1, wherein the transport system transports the product having the same product information to the downstream destination.

4. The device of claim 1, further comprising a diverter provided along the transport system, the diverter diverts the product of at least the stream of first pre-sequenced product into separate destinations.

5. The device of claim 1, wherein the at least first feeder has a feeding capacity rate greater than the at least second feeder.

6. The device of claim 1, wherein the pausing device pauses the stream of the second pre-sequenced product having the same or different product information until all of the product of the first pre-sequenced product with the same product information is processed to a downstream destination.

7. The device of claim 6, wherein the product with the same product information is formed into a defacto sequentially merged package.

8. The device of claim 1, further comprising a packager provided at a downstream destination, the packager packaging the product having the same product information into a sequentially merged package.

9. The device of claim 1, further comprising a packet former that forms a packet of the product with the same product information associated with the stream of first pre-sequenced product.

10. The device of claim 9, wherein the pausing device pauses the stream of the second pre-sequenced product until after the packet of the product with the same product information associated with the stream of first pre-sequenced product is formed into packet.

11. The device of claim 1, wherein the product information is one of destination information and sequencing information.

12. The device of claim 1, wherein:

the product having a lower order sequence number is processed prior to the product having a higher order sequence number; and

the pausing device pauses the product with the higher order sequence number until all of the product with the lower order sequence number is provided into the merged sequential order.

13. The device of claim 1, wherein the first pre-sequenced product is at least one letter and the second pre-sequenced product is at least one flat.

14. The device of claim 1, wherein the sequentially merged order or product is obtained from one of:

a portion of the stream of the first pre-sequenced product having the same information,

a portion of the stream of the second pre-sequenced stream product having the same information, and

a portion of the stream of both the first and the second pre-sequenced product having the same information.

15. The device of claim 1, further comprising at least a third feeder feeding a stream of third pre-sequenced product,

wherein the reading device reads product information of each product of the stream of the first, second and third pre-sequenced product and

wherein the pausing device pauses one of the first stream of pre-sequenced product, the second stream of pre-sequenced product and the third stream of pre-sequenced product based on the information read from the reading device such that product from one, both or all of the stream of the first, second and third pre-sequenced product with same product information determined in the reading step is organized into a sequentially merged order.

16. A method for merging in a sequential order a first type of product and a second type of product, the method comprising the steps of:

reading product information from a first stream of pre-sequenced products of the first type of product;

reading product information from a second stream of pre-sequenced products of the second type of product; and

merging in sequential order the first and second type of product of the first and second stream of pre-sequenced product having same product information determined in the reading steps.

17. The method of claim 16, further comprising the steps of:

pausing the first stream of pre-sequenced products when the first type of product in the stream has different product information, and

continuing the merging of the second type of product having the same product information into the sequential merged order.

18. The method of claim 17, further comprising the steps of:

restarting the first stream of pre-sequenced products of the first type of product;

determining whether another product in the second stream of pre-sequenced products has the different product information,

if the determination is positive, merging in sequential order the product of the first and second stream of pre-sequenced product, in a same order; and

if the determination is negative, pausing the second stream of pre-sequenced products and passing through the first stream of pre-sequenced products all having the different product information.

19. The method of claim 16, further comprising the step of determining whether all product with the same product information has been merged into the merged sequential order.

20. The method of claim 19, further comprising packaging all the product with the same product information into a packaged merged sequential order.

21. The method of claim 19, further comprising the steps of:

forming a packet of the first type of product with the same product information;

pausing the second type of product information with the same product information; and

merging the packet with the second type of product in the second stream of pre-sequenced products having the same product information.

22. The method of claim 16, wherein the merged sequential order is based on a same ordering of the pre-sequenced order of the first and second stream of pre-sequenced products.

23. The method of claim 16, comprising the steps of:

passing the first type of product of the first stream of pre-sequenced products with the same product information to a destination bin;

pausing the second stream of pre-sequenced products of the second type of product having the same product information until all of the first type of the product has been provided to the destination bin; and

moving the second stream of pre-sequenced products of the second type having the same product information to the destination bin thereby forming a defacto package.

24. The method of claim 16, further comprising the step of packaging in parallel different route segments associated with the sequentially ordered first and second type of product.

25. The method of claim 24, further comprising providing the packages for the different route segments in a sequential delivery point order.

26. The method of claim 16, further comprising:

merging in a sequential order the first type of product, the second type of product and a third type of product including the steps of:

reading product information from the first stream of pre-sequenced products of the first type of product, the second stream of pre-sequenced products of the second type of product and a third stream of pre-sequenced products of the third type of product; and

merging in sequential order the first, second and third type of product of the first, second and third stream of pre-sequenced product with the same product information as determined in the reading step.

27. A method for merging in a sequential order disparate product types comprising the steps of:

reading product information from a first stream of pre-sequenced products of the first type of product;

reading product information from a second stream of pre-sequenced products of the second type of product; and

merging into a sequential stream the first and second type of product of the first and second stream of pre-sequenced product having same product information as determined in the reading steps;

providing the merged sequential stream of the first and second type of product to separate destinations based on delivery point segments for parallel processing such that packages are formed of the first and second type of product having the same product information; and

removing the formed packages in delivery point sequence.

28. The method of claim 27, further comprising the steps of:

pausing the first stream of pre-sequenced products when the first type of product in the stream has different product information,

continuing the merging of the second type of product having the same product information into the sequential stream;

restarting the first stream of pre-sequenced products of the first type of product;

determining whether another product in the second stream of pre-sequenced products has the different product information;

if the determination is positive, merging in sequential order the product of the first and second stream of pre-sequenced product, in a same order; and

if the determination is negative, pausing the second stream of pre-sequenced products and passing through the first stream of pre-sequenced products all having the different product information.

29. The method of claim 27, further comprising the steps of:

forming a packet of the first type of product with the same product information;

pausing the second type of product information with the same product information; and

merging the packet with the second type of product in the second stream of pre-sequenced products having the same product information.

30. A machine readable medium containing code for merging in a sequential order a first type of product and a second type of product, comprising:

a module for reading product information from a first stream of pre-sequenced products of the first type of product;

a module for reading product information from a second stream of pre-sequenced products of the second type of product;

a module for merging in sequential order the first and second type of product of the first and second stream of pre-sequenced product having same product information.

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